THURSDAY, JUNE 21, 1877

THE ORGANISATION OF NATURAL HISTORY MUSEUMS

THE two questions connected with museum reform more especially demanding attention relate to their resources and their organisation.

Provincial museums are very generally either the property of societies the funds of which are expended mainly in publishing memoirs, or are carried on in connection with free libraries. With regard to the first, it is impossible that adequate means should be forthcoming for their efficient maintenance, and with regard to the second the library, as a rule, swallows up an inordinate share of the funds provided by a rate. Some are connected with teaching bodies. In nearly all cases they are poverty-stricken and largely dependent on casual benevolence for their support and increase. It is surely only just and fair that the funds necessary for making them efficient should be provided out of the public purse since they are for the public weal, as is the case in all other countries except our own. I do not advocate that the whole burden of this should fall on the public; it should certainly be borne in part by private individuals, who, if experience in other things be worth anything, are ready to subscribe liberally when a clear case has been made out that their liberality will be of practical use. The relation which the museum of natural history at Lyons bears to the Société des Amis des Sciences Naturelles illustrates my meaning, for while supported by the Municipality, it is largely indebted to the Society for the purchase of new and rare specimens. Why should not similar associations for similar ends be formed in connection with every important museum in this country? A well-arranged museum of any size is of necessity costly, and to be well officered must offer inducements other than those which tempt the badly-educated, the mere enthusiast, or the worsted in the struggle for life.

The abnormal connection between museums and libraries should be severed, as it is to be severed in the case of the national collections, because they have no real connection with one another. The officer who has the care of both, if they be of any size, cannot in the nature of things perform satisfactorily what he undertakes. If he give up his mind to the library he will probably neglect the natural history, or *vice versâ*. To this cause the chaotic state of many of our museums is to be assigned. A curator has not merely to catalogue and arrange, but he has to master thoroughly the collections under his charge, and in this respect he differs essentially from a librarian. A museum is one thing, and a library is quite another thing.

The Public Libraries Act of 1855 has certainly failed so far as relates to the establishment of museums, if the rapid development of other means of advancing knowledge during the last twenty-two years be taken into account.

On the very difficult question of museum buildings, it seems to me that the maximum amount of space and of light obtainable at the lowest cost consistent with good work should be the chief end, rather than a building with a fine outside. As a rule we content ourselves with mere externals. Well-supported collections in a big barn or an old cotton-mill are more likely to be useful than a grand building on which the greater part of the funds are likely to be spent to the starving of the museum within. This fact is fully recognised in the United States. In our wealthy centres of population there is no reason why we should not have large collections adequately housed, as is the case very generally on the Continent.

The best internal organisation of a museum which occurs to me is that which preserves as far as possible the continuity that exists both in nature and art, and in which the departments are arranged in the following order:—

1. Mineralogy and crystallography and petrology, including mineral products used in the arts. This should be approached from the point of view offered by chemistry.

2. Palæontology, illustrating the ancient history of life on the earth from the Eozoon to the beginning of the historical period, and consisting of fossils arranged stratigraphically, and divided as far as possible into three divisions within the limits of each group—the fauna and flora of the sea, of the fresh water, and of the land. Under this head prehistoric archæology is included.

3. Botany.

4. Zoology.—In this department it is wholly unnecessary to have every species mounted. The birds may very conveniently be represented by one stuffed specimen of a class, family, or genus, while the species are preserved for reference, and the skins occupy a small space in drawers, as in Dr. Sclater's collection at the Zoological Society.

4A.—Comparative osteology and anatomy are the natural offshoots of zoology, ranking under that head. I cannot, however, agree with those who hold that they should form part of the zoological series, since their chief value consists in their comparison with the like parts of other creatures. Were the collections of the Royal College of Surgeons arranged in the same cases with the zoology of the British Museum—dissections and bones of lions say with stuffed lions—they would at once lose their teaching value.

5. Ethnology, worked out as it is now being done by Mr. Franks in the British Museum, and Dr. Bastian in the Imperial Museum at Berlin.

6. Art.

This scheme is applicable to museums large and small.

In founding provincial museums the fauna, flora, and geognosy of the surrounding districts should receive the first attention, and to these may be added, if possible, a general collection. In all cases they should be connected with teaching. The principle of co-operation should be freely brought into play, and casts of the more important objects in each should be made for exchange and distribution. Each museum should be available for the general public, the local societies, and the teaching bodies of the place, schools, colleges, and the like. Were we to expend as much common sense and energy in this direction as in most others we should soon see our museums important instruments in spreading culture, and in a very different position to that which they now hold in relation to those

of other countries, in many ways worse off than our own. The subject is well worth the attention of all who have at heart the higher education of the people.

W. Boyd Dawkins

THE CARBONIFEROUS FLORA OF CENTRAL FRANCE

Flore Carbonifère du Département de la Loire et du Centre de la France. Par Cyrille Grand' Eury, Ingénieur à St. Étienne. (Imprimerie Nationale, Paris.)

THIS work consists of three quarto volumes, the first of which is devoted to the plants, the second to the geology of the districts under consideration, and the third forms an atlas with thirty-four plates of fossil plants and four large "tableaux," in which the author has "restored" the plants he has described according to his own ideas of their morphology.

It is very obvious that the carboniferous plants of one district cannot be received as altogether typical of those occurring at other and distant localities. Hence such publications as those of Dr. Dawson and Prof. Newbury in America, and the volumes of M. Grand' Eury, are extremely valuable to the English palæo-botanists. They tend to preserve him from the one-sided habit of viewing the subject which he is apt to contract when only studying the types occurring in his own coal-fields. But apart from this M. Grand' Eury's work has an independent value, especially in some departments in which he has made important additions to our stock of knowledge. This is especially the case with his investigations amongst the hitherto obscure plants known as Flabellariæ and Cordaites, as well as amongst some remarkable sporange-bearing ferns.

Our knowledge of Cordaites has hitherto been most vague; but M. Grand' Eury has fortunately obtained some beautiful specimens in which not only the leaves are attached to the stems of several species, but in some he also finds what he believes, I think justly, to be male and female organs of reproduction, thus establishing the point that these plants were monœcious Phanerogams. These organs are slender spikes, some of which support small scaly buds lodged in the axils of bracts, and which the author believes to have been antheriferous. Others bear single seeds in each axil. Some of the spikes are affirmed to be those of Antholithes, and the seeds to be identical with Cardiocarpus. The stems which bear these reproductive structures have a Sternbergian pith, surrounded by an exogenous woody zone inclosed within a distinct bark, which latter appears to have consisted of more than one layer. M. Grand' Eury concludes that these plants were Conifers, of which the well-known Dadoxylons were the ligneous axes, and that the type which survived for a time in some of the Ulmanniæ of the Lechstein, and in the Albertia of the Triassic rocks. I see nothing, however, in his figures and descriptions leading me to conclude that they are identical with our British Dadoxylous.

The new ferns described by the author are equally remarkable. They include numerous forms of Pecopteris, with very peculiar sori approaching those of the Marattiaceæ. Some of these fronds he associates unhesitatingly with Psaronius and other stems of tree-ferns. The author's researches on the above subjects have been conducted under most favourable conditions, of which he has availed himself in a praiseworthy manner.

When we come to the debateable subjects of Calamites, Lepidodendron, Sigillariæ, and Asterophyllites I am obliged to use different language. On these points the author adopts substantially the ideas of Brongniart. Thus he distinguishes between Calamites and Calamodendron, making the former an equisetaceous plant and the latter a gymnospermous one. I cannot understand how any one can do this in the face of our present knowledge of the facts.

In external form the supposed Calamites and Calamodendra exhibit precisely the same appearances. All these appearances are explained in the most exact manner by the internal structure of the many illustrative specimens which we now possess, and which demonstrate that we only have one type of organisation. Further, what are called Calamites by the school to which our author belongs are amongst the most abundant of the plants furnished by our coal-shales, and there is nothing to prevent their being equally common in the Oldham and other beds, in which all the plants retain their internal structure, if they existed as an independent type. But the moment we find a Calamitean plant with organisation it proves to be a Calamodendron. Even M. Grand' Eury is compelled to admit "il est au moins surprenant que l'on n'ait pas mis la main sur un Calamite avec la structure conservée." Very surprising, indeed, considering that we have obtained such numbers of these plants with structure from Oldham, Halifax, and Autun, as well as, though less abundantly, from Burntisland. The conclusion to be drawn is too obvious to need reiteration.

Imbued with these ideas respecting Calamites and Calamodendra, it was inevitable that M. Grand' Eury should fall into error respecting Asterophyllites. These plants are regarded by his school as the branches and leaves of Calamites. Hence he could not recognise as Asterophyllites any plant which had not a Calamitean axis. But I have shown that Asterophyllites has *not* such a structure, but one identical with the very different one of Sphenophyllum. M. Grand' Eury escapes the difficulty by contending that my plants are *not* Asterophyllites, but Sphenophylla. This is certainly not the case. Brongniart has clearly defined the latter genus a possessing 6–8 or 10 *truncate cuneiform* leaves; and after referring to the fructification of Sphenophyllum, he correctly says:—"Ce mode de fructification, malgré l'obscurité qui environne encore sa vraie structure, est trop analogue à celui des Astérophyllites pour qu'on puisse douter de l'affinité de ces deux genres." This conclusion is precisely identical with mine. Instead of 6–8 or 10 leaves in each verticil, my plants have 18 or 20. These leaves are linear, not cuneiform; and as my next memoir will demonstrate even more clearly than I have yet done, each leaf had a single central vascular bundle instead of the two or more invariably seen in Sphenophyllum.

In his views respecting the relations of Sigillaria and Lepidodendron, M. Grand' Eury also clings to the old Brongniartian ideas promulgated in bygone years. M. Brongniart and M. Renault have described the organisation of two Sigillarian fragments, *S. elegans* and *S.*

spinulosa, and have concluded that whilst their Diploxyloid organisation differs from that of the Lepidodendra, it justifies the conclusion that Sigillariæ were not lycopodiaceous but gymnospermous plants. But I have already shown that several indisputable Lepidodendra have precisely the same organisation. Hence I contend that Brongniart's reasons for separating these plants have no existence, and consequently his conclusions must be abandoned; M. Grand' Eury, forgetting this part of my work, and only remembering that I have also described the bark of a true Syringodendroid Sigillaria, and shown that it is identical in every feature with the corresponding tissue in Lepidodendra, says that I have arrived at my conclusion "par des faits isolés d'après l'analogue de l'écorce, et non par des exemples complets réunissant les caractères extérieurs aux caractères intérieurs." How, in the face of my published memoirs, my friend could make so erroneous a statement, I am at a loss to conceive.

I should have felt it necessary to have subjected the volumes under consideration to an incisive criticism on these and some similar points, were it not that he kindly allows me to quote from some letters which I have received from him. In these communications he says:—"Les points sur lesquels nous différons sont précisément ceux que je n'ai pas étudiés." Referring to facts which I have observed, he adds: "Comme je n'avais pas ces faits pour me guider, j'ai conclu d'après ce que je connaissais bien, et je ne suis pas fain de conclure que je me suis trompé; dans ce cas nous aurions dans les Sigillaires et les Lepidodendrons des cryptogames excessivement elevées en organisation; si elevées qu'ils formaient, en quelque façon, une classe intermédiare entre ces plantes et les Gymnospermes." "L'Association presque constante des macrospores avec le débris des Sigillaires est en faveur de vos conclusions." Quite in accordance with the above remarks are the following observations which the author makes in his volumes: "Il est au moins curieux que, à part le corps vasculaire, les autres parties des Sigillaires soient semblables aux parties correspondantes des Lepidodendrons." This is perfectly true with the exception that the vascular portions are less exceptional than M. Grand' Eury's remarks imply. The Sigillarian stem is merely that of Lepidodendron Harcourtii, *with an additional* exogenous vascular zone interposed between that of the Lepidodendron and its investing cortex; *and which I find in other true Lepidodendra.* If all the plants of the coal-measures which possess a similar exogenous zone are to be transferred from the cryptogamic to the phanerogamic group, there will be few cryptogams left in the carboniferous rocks beyond Lepidodendron Harcourtii and the ferns. M. Grand' Eury concludes his notice of the Sigillariæ by a remark which I fully endorse: "Seulement je crains d'avoir tiré des conséquences trop complètes de ces indices insuffisants, dont je n'aurais peut-être alors même dû parler que pour éveiller l'attention des observateurs sur une solution possible du plus important problème de la paléontologie végétale."

Having thus indicated some very important points respecting which I am compelled to differ from M. Grand' Eury, I can with the sincerest truth again express my sense of the value of this new contribution to the study of the carboniferous flora, and of the praiseworthy perseverance with which the author has laboured for many years in collecting his materials. The most prominent fact which the work reveals is the remarkable abundance of the Cordaites in the coal-measures of Central France, compared with what we see in England. In some districts, as M. Grand' Eury informs us, the coal is almost entirely composed of their *débris*. I have met with nothing like this in Great Britain, but it is in strict accordance with what we know of the distribution of living plants, that whilst similar types may be expected to be met with over wide geographical areas, some forms will predominate in one region, whilst in other localities different types will prevail; hence the materials out of which coal has been found must have been widely different at these various spots.

The plates with which the above work is illustrated are extremely beautiful, as is usually the case with the productions of the French lithographers.

W. C. WILLIAMSON

OUR BOOK SHELF

Annaes do Observatorio do Infante D. Luiz. Magnetismo Terrestre. Lisboa, 1876.

THIS part of the *Annals* of the Lisbon Observatory is a continuation of those noticed in NATURE, vol. xiii. p. 301. The results for the magnetic declination are carried forward from 1867 to 1871, while some include the means from 1858 to 1875. This is the case for the secular change and annual variation. Mr. Capello found previously that the north end of the declination magnet approached the north at the rate of 5′·91 yearly (1858-1868). The results he now divides into two series, 1858 to 1866, with a rate of 5′·46, and 1866 to 1875, with a rate of 7′·64 yearly.

The yearly means are deduced from observations at 8 A.M. and 2 P.M. Mr. Capello has also shown that the diurnal law of disturbance appears to be different at Lisbon in different years of the decennial period.[1] In this case, even if two observations daily were otherwise sufficient to give accurate means, or means strictly comparable from year to year, the varying effect of the disturbance on the observations at the two hours mentioned would of itself interfere with this comparability. It is probably for these reasons that the yearly means at Lisbon do not appear to show the small decennial inequality in the secular movement first indicated by me in 1857, and afterwards discovered by Hansteen and Lloyd.

Mr. Capello has repeated discussions for the magnetic disturbances with the increased materials in his possession. He had observed in a preceding number of the *Annals*, that many observations which were considered disturbed (that is to say, which differed from the means for the hours by 2′·26 or more) really belonged to diurnal variations which were regular, only larger than usual; and it was pointed out in NATURE (in the notice cited above) that one cause of these excessive deviations would be found in the superposed lunar actions. Mr. Capello now finds that a great majority of these quasi-solar disturbances are rather to be considered due to the moon. This conclusion induces me to believe that if Mr. Capello had the necessary aid to perform the calculations for the lunar diurnal variations for each month, and for different positions of the moon, as well as for other investigations, the Lisbon observations could not fail to add many important scientific results to those already published.

JOHN ALLAN BROUN

Incidents in the Biography of Dust. By H. P. Malet. (London: Trübner and Co.)

THE first impression one gets of this book is that of a

kind of nightmare. It begins by personifying dust and makes "us dusts" utter a great deal of incoherent talk which changes somehow into the voice of the writer himself, who by and by fades into Prof. Tyndall, then into "a weekly paper, *Punch*," then through Hugh Miller and the Holy Scriptures into the familiar tones of Mr. Henry Woodward, F.R.S., who gives way to the dusts again, and so on. The first impression, too, deepens upon further perusal. One never can be quite sure who is speaking; whether the "we" is the editorial pronoun or marks the utterances of the personified dust-motes. Sometimes, indeed, by a kind of feeble and perhaps, unconscious pun, it means both the author and "us dusts;" as where a sentence begins (p. 107), "Of all the authorities we have ever rested on, Sir Charles Lyell has described mountain formation most accurately." Or again: "Mrs. Somerville is a favourite authoress; we seldom find a protracted rest upon her volumes." The writer seems to have made a very hearty meal on all kinds of miscellaneous geological and other scientific and literary food. The variety and amount of the viands have been too much for him. Hence the wild speculations, the grotesque theories, the pell-mell rush of changing subject through the 272 pages of this curious but dreary volume. So completely has the nightmare taken possession of the author that in his frenzy he forgets the composition of the very air he breathes, and sententiously announces that while "the earth consists of air, water, and dust," the "air is composed chiefly of oxygen, hydrogen, and carbonic-acid gases." We would venture to suggest a good application of oxygen and hydrogen in the form of a shower-bath as a corrective. The book closes most appropriately with a spiritualistic *séance*, at which the *dramatis personæ* are a Medium, Spirit of Socrates, and Dust. If the author would discard all this "plain language," as he is facetiously pleased to call it, and tell us in simple straightforward English what it is all about, we should be prepared calmly to listen to him, but no more such "Biographies of Dust!"

Chemical Physics. By N. N. Lubavin. First fascicule. St. Petersburg, 1876, 346 pp., in 8vo. (Russian.)

THE author has given in a handbook a description of the various physical phenomena which, without belonging to the true domain of chemistry, are nevertheless involved in all chemical processes, and which can adequately be described as physico-chemical. These phenomena, of the highest importance for the student of chemistry who is interested in the philosophy of his science, are dealt with at length by the author in a very lucid and plain style. Without discussing advanced theories, M. Lubavin, in this first fascicule (the second being in the press) gives us only facts, and in a condensed form much useful information. He has carefully read what has been published in this department in France and Germany, but is not very familiar with our English works, except through German or French translations.

Enumeracion de los Vertebrados Fósiles de España. Por Don Salvador Calderon. (Madrid: T. Fortanet, 1877.)

THIS is a reprint from the *Anal. de la Soc. Españ. de Hist. Nat.*, tom. v., of Señor Calderon's valuable catalogue of the vertebrate fossils hitherto discovered in Spain, with an introduction and accompanying remarks. As the catalogue and an abstract of the introduction to it have been published in the *Quarterly Journal* of the Geological Society of London during the present year, it will not be necessary for us to do more than to call attention to the appearance of the work in its more complete form. Some interesting questions are opened up by the author concerning the distribution of several interesting Miocene forms such as Sivatherium, Hyænarctos, and Hipparion.

[1] See also Proc. Roy. Soc. (March, 1876.) Vol. xxiv. p. 273.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Museum Reform

EVERY one who puts faith in museums as educational engines must be grateful to Prof. Boyd Dawkins for the article on this subject in the number of NATURE for May 31. That reform is pressingly needed in most of our provincial museums is a proposition almost beyond question; but how such reform can be best effected is a subject open to any amount of discussion. The primary difficulty in organising a museum is usually a difficulty of finance. Money, which measures all things, measures the curator's power of procuring glass cases and suitable specimens. Where, then, the resources of a museum are very limited, the greatest amount of good will probably be effected by confining attention to the formation of local collections. Such work, being restricted within a narrow sphere, may be done thoroughly, even in the poorest museum. Yet it is work which will be valued by every true student of science. Prof. Blackie, in his "Self Culture," gives excellent advice when he says: "In order to assist in forming habits of observation in this age of locomotion I should advise young men never to omit visiting the local museums of any district, as often as they may have an opportunity; and when there to confine their attention generally to that one thing which is the most characteristic of the locality." Now it often happens that the things most characteristic of the locality are hardly thought worth exhibiting, and are precisely the things that we do not find in a provincial museum. Only last week I had occasion to visit a museum of thoroughly old-fashioned type, and to my surprise I found that the mineral industries of the neighbourhood, though of great importance, were absolutely unrepresented, whilst unlabelled curiosities collected from every quarter of the globe were heaped together in defiance of all principles of classification. It is true there is great temptation for a curator to display a little of everything, and a specimen from the Antipodes is no doubt regarded as a greater curiosity than a specimen from the neighbouring hills. But if a small museum is to have any educational value worth naming, its aims should be restricted, at least in the early stages of its development. Many museums undoubtedly teach too little by attempting to teach too much.

Perhaps the chief cause of unsatisfactory arrangement in so many museums is to be found in the difficulty of curatorship. Most museums naturally take their complexion from those who have charge of them; if the curator, for example, is a good entomologist, the collection of insects will be good; and so on. A general museum, indeed, needs a curator just a trifle less than omniscient. Even where each department is under charge of some honorary specialist, it by no means follows that the greatest educational value is got out of the collections. It seems to me that it would be an advantage, wherever practicable, to establish some kind of connection between the museum and the nearest college or other educational centre; assuming, of course, that it is a centre of liberal education where science asserts its proper position. Just as lectures teach principally through the ear, so museums teach through the medium of the eye; and those who have had most experience in oral teaching will probably be best qualified to assist in the oversight of an educational museum.

Another direction in which most museums imperatively need reform is in the simple matter of labelling. Too often the visitor leaves without carrying away much information, simply because he is unable to interpret what he has seen. A curator can therefore hardly be too free in the use of descriptive labels. Large labels, no doubt, occupy a good deal of space, and this can be ill spared in a crowded collection. Nevertheless, I believe it is far better to exhibit only half the number of specimens, fully telling their own tales, than to cram the cases with specimens unnamed or only meagrely described. If a museum is to be of real value educationally, it must be made as far as possible its own interpreter.

F. W. RUDLER

Scientific Club, Savile Row

I HOPE ventilation of this subject in the columns of NATURE will direct attention to the necessity of more systematic arrange-

ent, and that governors will seek to redeem these institutions rom the mere curiosity shop style into which too many have eveloped, and to render them valuable educational instruments.

Interested in geology, I have been pleased, in occasional visits ith pupils to our local museums, to note the gain to accurate nowledge as the diagrammatic illustration of the text-book is xchanged for the fuller teaching of fossil and specimen, and here, to chronological and stratigraphical plan, the character-tic fossils are indicated by special labels, and the time range hown by variously coloured mounts, the advantage is consider-ble. I would further suggest the desirability of numbering im-ortant objects, as in a picture gallery, and furnishing the visitor ith an attractive catalogue. Where several museums exist in he same town could not the authorities, by mutual agreement, oncmise space and effort by division of labour, each one be-oming to some extent exhaustive in a special direction?

In one of our best arranged museums I recently found, for ure want of room, Cambrian trilobites associated with basic ocks, and a fossil neatly stowed away in a case of Vesuvian roducts.

Bright, convenient, and well-keyed, our museums ought to ncreasingly attract students and gather in recruits from time to ime from the inquiring public. A good supply should in this, s in some other educational difficulties, create demand, and timulate public sentiment until our museums become so com-odious and well-appointed as to bear comparison with the xcellent models Prof. Dawkins refers to as established by our ontinental neighbours; and the natural sciences gain in dignity mongst us until they enter into healthy rivalry with the elder nd established studies of numbers and letters.

Manchester, June 2 WILLIAM GEE

I SEE with pleasure that Prof. Boyd Dawkins has again sed his voice urging the importance of museums as a means of ducation, but as there is one point regarding their management which it may be useful to call attention, I shall be glad if you ill allow me to do so through your pages.

Undoubtedly English museums compare most unfavourably ith foreign ones, and this partly arises from the idea which is prevalent that one man ought to be able to arrange and deter-ine anything from New Zealand birds, plants, or fossils to a lection of Egyptian idols. The consequence is that we see ith incongruities as were pointed out by Prof. Dawkins, to which should like to add another, from one of the leading technical stitutions of London; there a few years ago (and I suppose re are still), among building materials, some large Nummulites enus of fossil foraminifera), marked portions of brick made the Israelites for the Egyptians when they were allowed no aw.

n a middle-sized foreign town in any of the other civilised atries of Europe there is a museum in charge of men who e given their attention to various branches of science; even taly, which is much behind in this matter of museums, we in such towns as Turin a well-arranged museum with a con-rable staff of curators, with the minerals in the hands of one , the fossils in another, the vertebrates have, I believe, two or e of the staff to work at them, while the invertebrates are in hands of another, and in the same way the historical and nical portions are no doubt under adequate management.

hen we turn back to England we find such a humiliating as a town like Manchester with no museum worthy of a h-rate town.

will no doubt be some time before their importance is fully nised and therefore as museums are likely to be for a long insufficiently manned, might it not be a great advantage if mber of local museums joined together to employ specialists etermine different groups? Such work might no doubt be very cheaply, for such men would often be glad of the rtunity of so much material passing through their hands.

naturalist who was making any group, such as corals or acea, his subject, might visit the museums and would in a short time be able to determine and arrange the greater of the local collection, and might have those which required r research sent up to London for investigation at leisure the completion of his tour. ARTHUR WM. WATERS

derley Edge

The Antiquity of Man

VING carefully perused the proceedings that took place at ecent "Conference" on the subject of the antiquity of man at the Anthropological Institute, I confess to a feeling of disappointment. I had looked, if not for new geological facts, at least for something novel in the treatment of what was already known, instead of which the geological speakers seem, for the most part, to have merely reiterated opinions with which their names have been for some time identified. Thus my able opponent, Prof. Boyd Dawkins, does no more than restate views and conclusions which have already been controverted more than once, and to which, therefore, I need not reply here, as in so doing I should be only summarising what has been stated at length elsewhere. Mr. Dawkins's "case" and my own are now so fully before our fellow-hammerers that we may be well content to leave them for judgment to the future—a future which is probably not far off. Prof. Prestwich, again, while quite open to conviction that man may have lived in England in pre-glacial times, is yet strongly of opinion that all the human relics hitherto obtained in the south of England are of *post-glacial* age, because they occur in deposits that overlie "the boulder-clay." Now this conclusion would certainly follow if it could be shown that the "chalky boulder-clay" of East Anglia represents, as Prof. Prestwich thinks it does, the glacial period. Unfortunately it only represents one phase of that period. There is an *older* boulder-clay than that "chalky till," and there are two separate boulder-clays which are *younger*, as Mr. S. V. Wood has demonstrated. The East Anglian chalky boulder-clay was laid down, as I believe, during the climax of glacial cold, and is consequently much older than the upper boulder-clays that occupy the surface of Scotland and the North of England. For the evidence which has weighed with me in coming to this conclusion I must refer Prof. Prestwich to the account of the English glacial deposits, which is given in the second edition of my work on the Ice Age. The proofs and argument are too long to recapitulate here. That the East Anglian chalky till belongs to a much more ancient date than the upper boulder clays of Yorkshire and the North, must strike any one who will take the trouble to compare them. The East Anglian deposit has been subjected to long-continued and powerful erosion, and everywhere bears the impress of extreme antiquity, while the younger tills of the North have a comparatively recent appearance. Nor is this by any means all, for between the accumulation of the chalky till and the formation of the most recent boulder-clay or till of the North there certainly intervened one mild inter-glacial period. (There were in reality, as I believe, two such periods.) Now during the "last inter-glacial period"—that, namely, which preceded the deposition of the youngest boulder-clay of Yorkshire and the North—there certainly existed a land-surface in England over which the pleistocene mammalia roamed. The proofs of this are found in certain fresh-water and estuarine deposits which are met with near Hull and elsewhere, and which have yielded mammalian remains, and thousands of *Cyrena fluminalis* and other shells. Prof. Prestwich has himself described these beds and classified them as *post-glacial*, partly because they repose upon boulder-clay and partly on account of their fossil contents. But since the date of Prof. Prestwich's visit to the locality in question, the section (near Burstwick) has been much better opened up, and now one may see *resting upon these so-called post-glacial deposits a thick mass of tumultuous boulder-clay*. This boulder-clay is in my opinion as truly the product of glacier-ice as any ground-moraine or till in Scotland, Norway, or Switzerland, and points to a time when all Scotland and the northern districts of England, down as far as the valley of the Humber, were shrouded in snow and ice.

With reference to the recent discoveries by Mr. Skertchly near Brandon, which Mr. Evans and Prof. Hughes have convinced themselves lend no support to the view that man is other than post-glacial, I would ask geologists to suspend their judgment until they have had an opportunity of hearing the other side. Let them exercise a little of that "caution" which Mr. Evans desiderates, and not too readily acquiesce in his and Prof. Hughes' ruling. Mr. Skertchly, who has mapped the ground about Brandon and Thetford, and whom we may suppose, therefore, to be more intimately acquainted with the geology of that district than either of his opponents, has no doubt that certain implement-bearing brick-earths are covered by boulder-clay *in situ*. I have also carefully examined the sections in question and feel quite sure that Mr. Skertchly is right, and that the overlying accumulation is a true glacial deposit, and an integral portion of the so-called chalky boulder-clay. Prof. Ramsay, who has likewise recently visited Brandon, is, I believe, of the same opinion. But the occurrence of flint implements underneath the chalky till of East Anglia is, after all, no proof that

these relics are pre-glacial. The most one can say about them is simply this, that the folk who used them lived in England before the climax of glacial cold. When human relics are got in beds of older date than those at Cromer, we shall then have a demonstration of the pre-glacial age of man in Britain. At the same time the presumption is (as many geologists will admit) that some portion of our ancient river-drifts and cave-deposits with flint implements do really belong to pre-glacial times. In short, after carefully reading the proceedings at the recent Conference, I find nothing to shake me in my present belief that none of the palæolithic deposits belongs to post-glacial times, but that all must be relegated to inter-glacial, and probably pre-glacial ages, and consequently that the palæolithic is separated from the neolithic age by the intervention of the last cold period of the glacial epoch. My opinion, therefore, is still as strong as ever that "until we clearly understand what was the succession of changes during the ice age, it is premature to speculate upon the geological age of those deposits which yield the earliest traces of man in Britain." In concluding, may I be allowed to suggest to the anonymous writer whose communication on the subject of the Antiquity of Man appears in the number of this journal for June 7, that before he again essays to criticise my views he might do well to become better acquainted with them. JAMES GEIKIE

Perth, June 15

BEFORE your readers accept the statements of Messrs. Evans and Hughes respecting my discovery of flint tools beneath the great chalky boulder-clay, as announced in NATURE last year, may I ask them to remember that as yet I have not published the evidence upon which I founded my statement? The delay has arisen from official and other causes; and although my paper is now written, it is, I have just learned, too late for reading during the present session at the Geological Society. Neither of the two gentlemen named is aware of the extent of my evidence, for I have not, as yet, told any one about it, except the two geologists mentioned below. As I shall show, there are now known to me about forty localities in which the brick-earths in question occur, and in most of them their relation to the boulder-clay is very clear; and even in the two or three spots in which that rock is not seen in the actual section, it overlies the implement beds near by on the same outcrop. The brick-earths have naturally suffered much denudation by the boulder-clay, and I have a splendid series of sections showing every phase from almost undisturbed material beneath the boulder-clay to small fragments (boulders, in fact) in that deposit. I wish, also, to state, that instead of four implements from two localities, as originally announced, I know at present nearly 150 from six different spots. The evidence is so clear and overwhelming when seen *en masse*, that it must be convincing to all who carefully weigh it. The boulder-clay which overlies the brick-earths in question is part and parcel of the great mass of the chalky boulder-clay, a formation which I have spent eight years in examining in the field almost daily, of which I have mapped about 2,000 square miles, and upon which I feel quite competent to form an opinion.

Prof. Prestwich is perfectly correct in ascribing the well-known palæolithic implements found in the gravel to a time subsequent to the formation of the chalky boulder-clay; *but that only proves those tools to be newer than the last glaciation of this particular area.* Now inasmuch as Mr. Searles V. Wood, jun., long ago proved, and as everybody who examines the ground must admit, that the "purple" and "hessle" boulder-clays are newer than the one we are dealing with, and as Dr. J. Geikie has shown that gravels bearing the same character and possessing the same peculiar fauna as the well-known palæolithic gravels (overlying, moreover, the chalky boulder-clay), pass under these newer beds, it is, to say the least, a misnomer to call these gravels *post*-glacial. They are post-glacial to this East Anglian area, but not to northern England; and the distribution of surface-beds containing palæolithic implements throughout Europe shows that they are confined exclusively to that area which was free from the erosive action of the newer and less intense ice-sheets of the latter part of the "Great Ice Age." Much of the misapprehension in this matter has arisen from the unfortunate name of "upper" given to the chalky boulder-clay. It *is* "upper" in East Anglia, but it is "lower" in Yorkshire.

My discovery does *not* prove man to have been pre-glacial; it merely shows that he was "pre-chalky-boulder-clay," and I last week obtained evidence to show that the brick-earths in question belong to the "middle glacial" of Mr. Searles V. Wood, jun.; that is to say, they are newer than the Cromer till, but older than the chalky boulder-clay.

Mr. Belt is mistaken respecting the quartzite implements near Brandon. They are found in gravel which is unquestionably above the boulder-clay, as can be seen in hundreds of sections, and the only conceivable source of that material is the boulder-clay. We have, in fact, two horizons of palæolithic implements, one above and one below the boulder-clay, and I am in hopes that the former will be found capable of subdivision, for many facts crop up in the course of my daily work which seem to point in that direction.

Prof. Ramsay and Dr. J. Geikie, who are eminently capable of judging of glacial phenomena, have gone over the area with me, and are perfectly convinced of the accuracy of my determinations. SYDNEY B. J. SKERTCHLY

Brandon

Nicephore Niepce

THERE is an error in one of your "Notes" of last week which you may be glad to have corrected. It is not to Niepce de St. Victor that the citizens of Chalons-sur- Saône (a town, by the way, not to be mistaken for Chalons in the Champagne country) are about to erect a statue, but to his uncle, Joseph Nicephore Niepce, who might well be designated as the first photographer, since he it was who succeeded first of all in fixing an image in the camera. In a "Life of Nicephore Niepce," recently published by Victor Fouqué. appear letters which leave little doubt that in May, 1816 Niepce had accomplished the feat of fixing shadows in the camera, for in a communication of that date to his brother he incloses four photographs, of which he says: "The pigeon-house is reversed on the pictures, the barn, or rather the roof of the barn, being to the left, instead of the right. The white mass which you perceive to the right of the pigeon-house, and which appears somewhat confused, is the reflection upon the paper of the pear-tree, and the black spot near the summit is an opening between the branches of the trees. The shadow on the right indicates the roof of the bake-house." This, then, is a description of the first camera-picture ever taken, and it was by reason of Niepce's inability to prevent his impressions from fading after a lapse of time that he turned his attention to the bitumen of Judea process, with which he produced photographs as early as 1824, one or two specimens being still among the science treasures of the British Museum.

The name of Nicephore Niepce is little known in England. And yet this should not be. As is well known he came to this country in 1827, and resided at Kew in the hope to receive aid and encouragement, and shortly afterwards, on his return to France, entered into partnership with Daguerre to work out together a more practical process. When Daguerre made known his discovery in 1839, his partner had been dead two years, and no mention was made of Niepce at the time Arago made his famous speech announcing the discovery of Daguerreotype. Specimens of the wonderful process were not long in reaching this country and the first picture was placed in Faraday's hands with the remark that he had never seen anything like it before. But Faraday said he had. A Frenchman, he remembered, had brought him a picture of Kew Church a dozen years ago, with the quaint remark, that "the sun had done it." Faraday was so certain of this that inquiries were at once instituted into the matter, and in the end, a communication was addressed by the Secretary of the Royal Society, Mr. Bauer, to the *Academie* at Paris, a communication which helped materially to substantiate the claim of the Niepce family and to obtain for the son Isidore, a pension in acknowledgment of the father's services. The deed of partnership between Niepce and Daguerre is still extant, but how much of the latter's published results were due to his dead partner the world will never know. H. BADEN PRITCHARD

June 16

Japanese Mirrors

THERE is still something to be solved about the Japanese mirrors, which show the figures that appear in relief on the back in the disk of light reflected from the face. Not only does it seem impossible (without some indication which I have not yet met with) to tell which mirrors in a series will perform the feat, but it is equally difficult to say why one bunch of leaves will, and another in the same casting, will not appear in the spectrum.

In reference to Mr. Highley's quotation of Mr. Prinseps' conjecture (p. 132), "that the thinnest parts, from being the hardest

[1] "La Verité sur l'Invention de la Photographie."

should give the strongest reflection, owing to a difference in density produced by stamping," and to the brassworker's solution, not only are the mirrors not stamped, but cast; but it is the thicker parts, those which stand out on the back in highest relief, which reflect the most light. I have one on the back of which there are two large characters as it were laid upon a background of trees. These letters have been carefully ground flat and polished like the front. Their figures not only appear more distinctly than those of other less highly raised adornments, but actually, in the sun, throw off a brilliant white light, which contrasts very markedly with the comparatively subdued spectrum from the rest of the plate.

Is it possible that there may be some difference in molecular arrangement during the consolidation of the melted metal in the thicker (relieved) and other parts of the plate? And yet, the thick rim of the mirror does not reflect a rim of light.

One of my specimens has suffered a little oxidisation, and I observe that this appears on the face to follow certain of the larger masses of relief on the back. This mirror does "not "show the pattern through," but there is a curious bright rim reflected from the edge of each scar of injured surface.

Manchester R. D. DARBISHIRE

Colour-Sense in Birds

As the fact of the preference of sparrows for *yellow* crocuses still excites interest and requires explanation, perhaps you will allow me to call attention to the following remarks of Gilbert White in his "Observations on Nature":—

"Birds are much influenced in their choice of food by colour, for though white currants are a much sweeter fruit than red, yet they seldom touch the former till they have devoured every bunch of the latter."

The obvious criticism that the craving for sweets which distinguishes the human biped is not equally predominant among his feathered friends, and consequently, that their selection of the less sweet but more highly coloured fruit may be due to some taste other than the æsthetic, does not detract from the importance of White's generalisation that birds are much influenced in their choice of food by colour—a generalisation which, there is no reason to doubt, was based upon his own keen and repeated observation. PAUL HENRY STOKOE

Beddington Park

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—The following are Greenwich mean times of visible geocentric minima of Algol, for July, August, and September, according to the elements adopted by Prof. Schönfeld:—

	h. m.		h. m.		h. m.
July	11 11 51	... Aug.	20 15 11	... Sept.	12 13 39
,,	31 13 31	... ,,	23 11 59	... ,,	15 10 28
Aug.	3 10 20	... Sept.	9 16 51	... ,,	18 7 16

Minima of S Cancri occur on September 8 at 15h. 1m., and September 27 at 14h. 14m:

A minimum of Mira Ceti will fall on July 23, according to Argelander's formula of sines, the same perturbations being applied as in the case of the maximum of the year, which is computed to occur November 97.

Mr. John Tebbutt, writing from Windsor, N.S. Wales, on April 13, states that in consequence of remarks on the probable variability of μ Doradûs, in NATURE, vol. xv. pp. 14 and 281, he examined the star on February 26, and March 14, and found it of the 8th magnitude. There is a star, estimated 9th magnitude, about thirty seconds of time west, and twelve seconds north of it. With such an instrument as was employed by Lacaille at the Cape of Good Hope in 1751, μ Doradûs, with its present brightness, would hardly have been visible. Lacaille calls it a fifth magnitude.

MINOR PLANETS AND COMETS OF SHORT PERIOD.—Dr. von Asten, in the course of his recent researches on the motion of Encke's comet, found that, although in the interval 1819-68 the comet had experienced in each period of revolution an almost exactly equal amount of acceleration, and that this might be attributed to the existence of a resisting medium, yet in order to connect the last two appearances in 1871 and 1875 with the previous ones, it is necessary to have recourse to the hypothesis of an extraordinary perturbation which, in the period 1868-71, counteracted the influence of a resisting medium. For certain reasons Dr. von Asten is led to conjecture that about the middle of the year 1869, when the comet was in the region occupied by the numerous group of small planets (the radius-vector being about 3·2), it made so close an approach to one of these bodies, as yet undiscovered, that a sensible effect on the comet's mean motion was the result.

In connection with this hypothesis it may be interesting to note that the late Prof. Hubbard, whose masterly investigations on the motion of Biela's comet appeared in Gould's *Astronomical Journal*, came to the conclusion that the separation of the comet into two distinct bodies, by whatever cause effected, took place in all probability in a heliocentric position corresponding to about longitude 318°·6, latitude + 12°·0, with radius-vector 4·36, which position the comet occupied in November, 1844 (*Ast. Journ.*, No. 140). It is stated in some works that the comet in 1846 separated under the very eyes of astronomers; nevertheless it is upon record that the companion was first recognised on December 29 by Herrick and Bradley at New Haven, but was not again seen until Maury refound it on January 13; and its not having been remarked when the comet was first glimpsed in the Northumberland and other powerful telescopes may well have been owing to distance and faintness.

A radius vector of 4·36 would, until quite recently, have been considered as placing the comet rather outside the probable superior limit of distance of the minor-planet group, but the discovery of Hilda by M. Palisa in November, 1875, considerably extended the limit, this body in aphelion being distant from the sun 4·6. Although the separation of Biela's comet, if it really took place at the epoch assigned by Prof. Hubbard, could not have been owing to an encounter with this particular planet, yet the position indicated for the occurrence is clearly a possible one for a meeting with an unknown member of the group. In saying this much we are of course aware that the separation may have been owing to a very different cause, indeed it might be supposed that such a *rencontre* would have left a more sensible effect upon the mean motion of the comet.

METEORIC FIRE-BALLS IN AMERICA.—Prof. Daniel Kirkwood in a communication to the American Philosophical Society, on March 16, gives some particulars of meteoric fire-balls which appeared in unusual number in the United States in the latter part of 1876 and beginning of the present year. The circumstances attending the appearance of eight conspicuous meteors are included; the dates were 1876, July 8 (two fire-balls), December 16 and 21, January 3, 20, and 23, and February 8. The train of the larger meteor of July 8 was visible at least forty minutes, the mass having been apparently dissolved or dissipated in the latter part of its track; the motion about the sun was retrograde, but sufficient materials were not forthcoming for determining the orbital velocity or the nature of the orbit. The fire-ball of December 16 had been visible but a few seconds near San Francisco when it apparently plunged into the Pacific at no great distance from the shore, the fall being followed by a loud detonation. The meteor of December 21 was remarkable for the length of its track, between 1,000 and 1,100 miles, one of the longest upon record, and, moreover, the track would appear to have been somewhat curved. When crossing Indiana the principal fire-ball was followed by a train of smaller meteors, many of which exceeded Venus and Jupiter in apparent magnitude; the breadth of the cluster, as seen from Bloomington, was 3°, and the length at least 20°, from which Prof. Kirkwood concludes that the true diameter was five miles; and the length about forty miles; several explosions occurred during the passage of the meteorite over Indiana and

Ohio, and a fragment weighing about twelve ounces, fell upon a farm near Rochester, Indiana, a part of it being secured by Prof. Kirkwood. The body is described as "peculiar in its structure; being pisolitic and remarkably friable." It is inferred that no part of the mass could have escaped out of the atmosphere. The aerolite of January 23, or rather a portion of it, after the final explosion, reached the earth in Kentucky, and is now in the collection of Dr. J. Lawrence Smith, of Louisville. The report is stated to have resembled discharges of heavy ordnance, in such close succession, that the different discharges were barely distinguishable; height at first appearance about seventy miles.

THE TRANSIT OF VENUS, 1882.—In *Astron. Nach.*, Nos. 2133-4, we have another calculation of the elements of this transit from M. Leverrier's Tables; it is by Dr. Deichmüller, of the Observatory at Bonn, who has followed Prof Oppölzer's method for the necessary data for reduction of the observations which are interpolated down to short intervals in Paris time. There are special calculations for certain principal stations.

THE LAND OF HISSAR AND KOLAB

THE eastern part of the dominions of the Emir of Bokhara is the belt of land between 37° 30′ and 39° N.L., and 67° and 71° E.L., bordered on the north by the now Russian province of Samarkand and the Karategin, and on the south by Afghanistan (the Balkh, Kunduz, and the Badakshan districts). It has hitherto been all but totally unknown. M. Maïeff, after having, together with Lieut. Vishnevsky and M. F. Schwarz, thoroughly explored it in 1875, gives us a description of the land of Hissar and partly that of Kolab (*Isvestia* of the Russ. Geog. Soc., 1876, 4th fasc.), with an elaborate map, based on numerous determinations of latitudes and longitudes, surveys, and barometrical measurements of heights.

Two great rivers running east and west, the upper Zerafshan on the north, and the Pandsh, or Upper Oxus, on the south, are the natural boundaries of the country. A third river, the Shehrsebz, running in the same direction under 39° N.L., borders its north-western corner, and a mass of high table-lands, the Pamir, rises to the east of the Kolab district. The whole land is filled with mountains belonging to the Tian Shan system. Two main ridges, which both run north-east to south-west, and are divided by the broad valley of the Surhan,[1] form the backbones of this hilly tract. Secondary ridges, either parallel to the main ones, or spreading out of them, fill the country. But at their western extremities, the mountain ridges are far lower than we know them to be in the east. Thus, the ridge between the Shehrsebz and the Surhan, now called the Hissar Ridge,[2] rising above the snow-line in its eastern parts, is far lower in the western; and its highest pass, Ak-rabat, is but 4,590 feet high, whilst other passes are as low as from 2,200 to 3,600 feet above the sea-level. The second main ridge, lying to the east of the broad Surhan valley and running between it and that of the Vaksh, seems to be higher, but yet far below the highlands of Kokand or of Eastern Turkestan. Besides, the highlands are deeply cut into by large and broad valleys which have in their lower parts a prevailing direction south by west, running thus to the Oxus. The north-western slope of the Hissar ridge is drained by only one river, the Guzar-daria, an affluent of the Shehrsebz; but, instead of being an insignificant stream, as on our present maps, it appears as a mighty river fed by the perpetual snows of the Sengri-dag, and its upper shores are occupied by a numerous population. East of the Hissar ridge we see a series of broad well-peopled valleys. First, that of the Shir-abad, from about 2,500 to 900 feet high, with the towns Derbent, Baisun, and Shir-abad. Next, the valley of the Surhan river which, as well as the Guzar and the Shir-abad, rises in the snow-covered ridge Meshai-Kentely, and receives many affluents. Some time before its annexation to Bokhara, this valley was a centre of the political life of the country, and, going back in its history, we come to a time when—a local tradition says—the population was so dense that a cat could travel upon the roofs of the dwellings from Denau to the Amu. Now, the population is concentrated in the upper, better-watered parts of the valley, where we find the towns Kara-tag, Sary-djui, Yourchi, and Denau. Further east we have the valley of the Kafirnagan (the Ramid of Ibis-Dast), the source of which is about Paldorak, this river being second in size to the Surhan. An enlargement in the upper parts of its valley, running east and west, is well peopled, and contains the towns Hissar, Fyzabad, Kafirnagan, and Doshambe. Then, below Hissar, the river enters a deep ravine, Pavi-Duldul (the foot of the Duldul, the mythic horse of Ali), at the issue of which is the town Kahadian (460 feet high), close to the Amu-daria.

Further east, beyond the second main ridge alluded to above (its local names are—By-katyn, Mazi-melek, Avantau, &c.), we have the basins of the Upper Oxus, *i.e.*, of the Vaksh (or Surhab) and the Pandsh, which both, M. Maïeff observes, must be considered as the sources of the Oxus. The former rises in the glaciers of the Alai-ridge and runs, under the name of Kyzyl-soo, on the Pamir table-land. After having received a great affluent, the Muk-soo, the river bears the name of Surhab and enters the Bokhara dominions through an impracticable deep ravine, at the well-known bridge Pooli-sengui. After a short course among mountains it soon emerges on a plain some 500 feet high. Divided into many branches, the main one about 180 yards broad, it runs to its junction with the Pandj near Kurgan-tube. Only one of the affluents of the Pandj, the Kchi-Surhab (little Surhab), was explored by M. Maïeff; it is formed by two rivers, the Baldshoan and Kolab, the valley of the latter being well peopled and cultivated, notwithstanding the extensive marshes which have given their name to the town, Kolab.

The population of the country consists of Usbecks and Tadjicks, the former occupying mostly the lower and better parts of the valleys, having driven the Tadjicks back to the upper parts. The banks of the Amu-daria, and especially the western parts of the country, are mostly peopled with Kungrad-Usbecks, the Tadjicks appearing more numerous to the east. The towns contain, as usual, a very mixed population. The lower parts of the Vaksh and the Kolab valley are mostly peopled by Usbecks of the Katagan tribe. Some Kirgises have begun to found settlements in the lower parts of the Vaksh and Pandsh valleys; and some miserable Turkomans are strewn among the Usbecks on the shores of the Amu. Jews, Hindoos, and Afghans form a very small percentage of the population.

As to the climate of the country, it is easy to perceive that it must be comparatively mild. In the higher parts of the Kafirnagan valley there are occasionally falls of snow about two feet deep, but the lower parts of the valleys have a mild, rainy winter. Figs grow at Shir-abad unsheltered during the winter. All kinds of corn and fruits common to Central Asia are produced in abundance. Cotton, however, is cultivated only in Shir-abad, owing to facility of export to Karshi (on the Shehrsebz). Rock-salt is worked in the neighbourhoods of Guzar and on the Upper Vaksh, but it must be found also elsewhere, the salt springs being numerous. Two gold mines are known on the shores of the Vaksh, and richer ones are reported to exist in the Darvaz.

The country is under the dominion of the Emir of Bokhara, being administered by nine *becks*, vassals to the emir, seven in the Hissar district, and two in that of Kolab.

[1] Tupalik on Mr. Arrowsmith's map in the *Journ. Roy. Geog. Soc.*, 1875. Tupalan is the name of one of the upper affluents of the Surhan.

[2] Its local names are Bash-kurd, Baisun-tau, Meshai-kenteli, &c.

HOW TO DRAW A STRAIGHT LINE[1]

IV.

I NOW come to the second of the parallel motions I said I would show you. If I take a kite and pivot the blunt end to the fixed base and make the sharp end move up and down in a straight line, passing through the fixed pivot, the short links will rotate about the fixed pivot with equal velocities in opposite directions; and, conversely, if the links rotate with equal velocity in opposite directions, the path of the sharp end will be a straight line, and the same will hold good if instead of the short links being pivoted to the same point they are pivoted to different ones.

To find a linkwork which should make two links rotate with equal velocities in opposite directions was one of the first problems I set myself to solve. There was no difficulty in making two links rotate with equal velocities in the same direction—the ordinary parallelogrammatic linkwork employed in locomotive engines, composed of the engine, the two cranks, and the connecting rod, furnished that; and there was none in making two links rotate in opposite directions with *varying* velocity; the contraparallelogram gave that; but the required linkwork had to be discovered. After some trouble I succeeded in obtaining it by a combination of a large and small contra-parallelogram put together just as the two kites were in the linkage of Fig. 18. One contra-parallelogram is made twice as large as the other, and the long links of each are twice as long as the short.

The linkworks in Figs. 30 and 31 will, by considering the thin line drawn through the fixed pivots in each as a link, be seen to be formed by fixing different links of the same six-link linkage composed of two contra-parallelograms as just stated. The pointed links rotate with equal velocity in opposite directions, and thus, as shown in Fig. 28, at once give parallel motions. They can of course, however, be usefully employed for the mere purpose of reversing angular velocity.

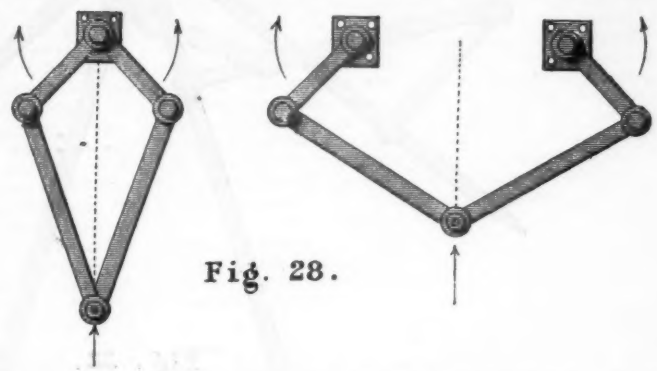

Fig. 28.

An extension of the linkage employed in these two last figures gives us an apparatus of considerable interest. If I take another linkage contra-parallelogram of half the size of the smaller one and fit it to the smaller exactly as I fitted the smaller to the larger, I get the eight-linkage of Fig. 32. It has, you see, four pointed links radiating from a centre at equal angles; if I open out the two extreme ones to any desired angle, you will see that the two intermediate ones will exactly *trisect the angle*. Thus the power we have had to call into operation in order to effect Euclid's first postulate—linkages—enables us to solve a problem which has no "geometrical" solution. I could of course go on extending my linkage and get others which would divide an angle into any number of equal parts. It is obvious that these same linkages can also be employed as linkworks for doubling, trebling, &c, angular velocity.

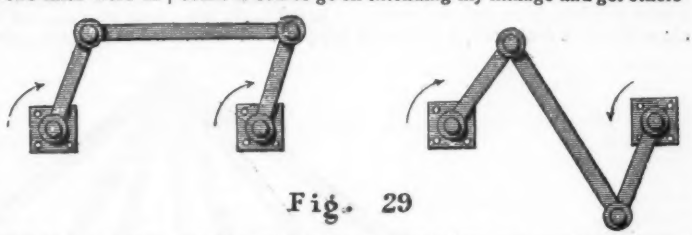

Fig. 29

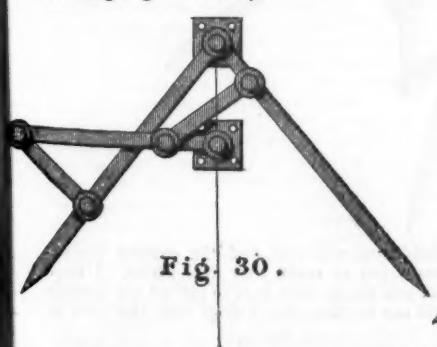

Fig. 30.

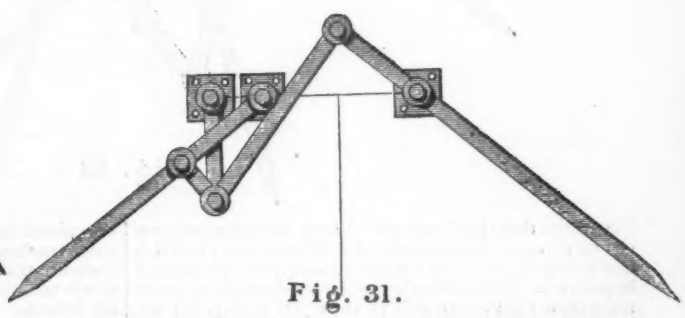

Fig. 31.

Another form of "Isoklinostat," for so the apparatus is termed by Prof. Sylvester, was discovered by him. The construction is apparent from Fig. 33. It has the great advantage of being composed of links having only two pivot distances bearing any proportion to each other, but it has a larger number of links than the other, and as the opening out of the links is limited, it cannot be employed for multiplying angular motion.

Subsequently to the publication of the paper which contained an account of these linkworks of mine of which I have been speaking, I pointed out in a paper read before the Royal Society, that the parallel motions given

[1] Lecture at South Kensington in connection with the Loan Collection of Scientific Apparatus, by A. B. Kempe, B.A. Concluded from p. 127.

there were, as well as those of M. Peaucellier and Mr. Hart, all particular cases of linkworks of a very general character, all of which depended on the employment of a linkage composed of two similar figures. I have not sufficient time, and I think the subject would not be sufficiently inviting on account of its mathematical character, to dwell on it here, so I will leave those in whom an interest in the question has been excited to consider the original paper.

At this point the problem of the production of straight-

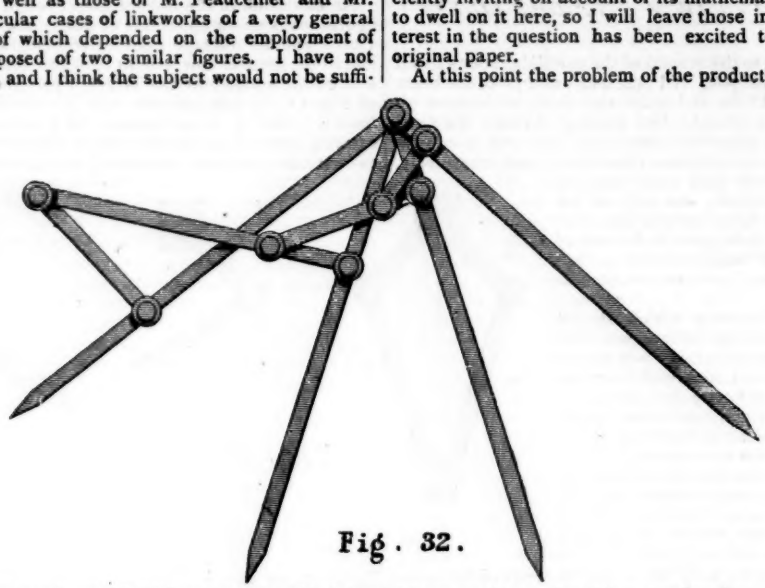

Fig. 32.

line motion now stands, and I think you will be of opinion that we hardly, for practical purposes, want to go much farther into the theoretical part of the question. The results that have been obtained must now be left to the mechanician to be dealt with, if they are of any practical value.

I have, as far as what I have undertaken to bring before you to-day is concerned, come to the end of my tether. I have shown you that we *can* describe a straight line, and *how* we can, and the consideration of the problem has led us to investigate some important pieces of apparatus.

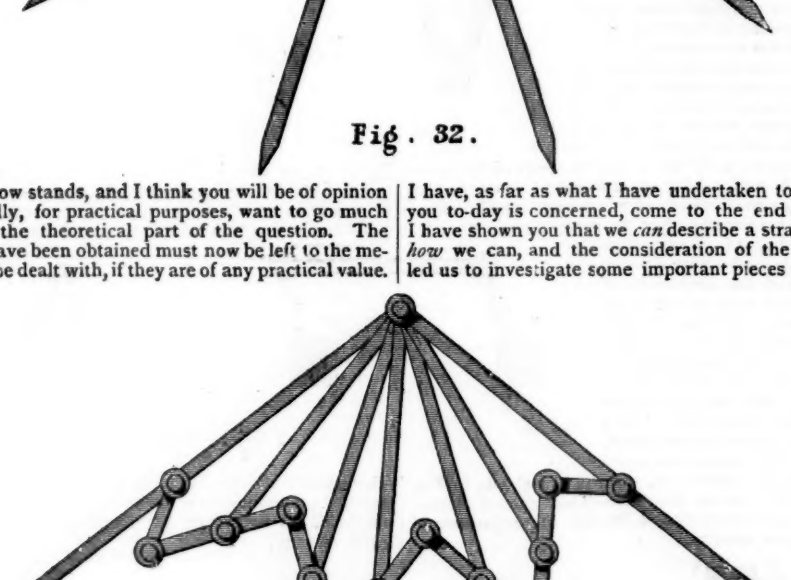

Fig. 33

But I hope that this is not all. I hope that I have shown you (and your attention makes that hope a belief) that this new field of investigation is one possessing great interest and importance. Mathematicians have no doubt done much more than I have been able to show you to day, but the unexplored fields are still vast, and the earnest investigator can hardly fail to make new discoveries. I hope therefore that you whose duty it is to extend the domain of science will not let the subject drop with the close of my lecture.

BIOLOGICAL NOTES

THE TICHORHINE RHINOCEROS.—A number of the *Memoirs* of the Imperial Academy of Sciences of St. Petersburg just issued contains an elaborate article on the Tichorhine Rhinoceroses by the veteran naturalist, Dr. J. F. Brandt. Dr. Brandt treats of two extinct species under this category, which he calls *R. antiquitatis* (i.e., *R. tichorhinus*, auctt.) and *R. merkii*. With the latter he proposes to unite *R. etruscus* of Falconer. Remarks are added upon *R. leptorhinus* of Cuvier and other allied species. When we consider the number of valuable con-

tributions to science recently made by Brandt, Middendorf, Kowalewski, Radde, von Schrenck, and other distinguished names of the Academy of St. Petersburg, it becomes somewhat ridiculous to a naturalist to hear the oft-repeated assertion of the British patriot "that the Russians are as great barbarians as the Turks!"

OSCAR HERTWIG ON THE PHENOMENA OF FERTILISATION.—The last number (Vol. iii., Part 1) of the *Morphologisches Jahrbuch*, contains the second part of Oscar Hertwig's very important researches on the phenomena immediately preceding the cleavage of ova in the Echinoid *Toxopneustes*, in two genera of leeches, and in the amphibia. He has watched most carefully the process of fertilisation and the ova before fertilisation, and has examined them after the action of various reagents. His accounts are accompanied by very valuable figures. From his own observations, and a comparative study of other recorded facts, he appears to have made generalisations worthy of the attention of all biologists. The following is a brief summary of his conclusions. The unripe ovum is characterised by the possession of a germinal vesicle, distinguished from all cell-nuclei by its great relative size, by its definite membrane, its more or less fluid contents, and its possession of one or several nucleoli. The germinal vesicle in this signification does not become the nucleus of the first cleavage-sphere; in many animals it disappears long before fertilisation, in other cases during that process or during the ripening of the ovum. At any rate the germinal vesicle loses all its distinctive characters. The active nuclear substance, or a part of it, remains and forms a new nucleus of much smaller size, lacking a distinct membrane and true nucleoli. From a highly differentiated form is produced a primitive nucleus; instead of a germinal vesicle we have an ovinucleus. In Toxopneustes the retrogression of the germinal vesicle is accompanied by its movement to the outer surface of the yolk, where it disappears, with the exception of the germinal spot; the latter again reaches the centre of the yolk and becomes the nucleus of the ripe ovum. In Hirudineæ there is an accessory prelude to fertilisation, the budding-off of "directive bodies" immediately after oviposition. After this arises a spindle-shaped ovinucleus really derived from the breaking up of the germinal spot. In amphibia the exceedingly large germinal vesicle gets to the surface and disappears. Only a small portion, one or more nucleoli, passes over into the inconsiderable ovinucleus. The parts of the germinal vesicle not contributed to the ovinucleus seem no longer serviceable, and get transformed into the so-called excretory bodies and sphere. In Amphibia a mass of this kind appears as a yellowish covering over the dark pole of the egg. Like Toxopneustes appear to be Medusæ, Siphonophora, Ascidians, some Vermes, Arthropods, &c., possessing in the ripe and unfertilised ova a small homogeneous, membraneless nucleus in the middle of the yolk or on its periphery. The Hirudineæ resemble Gasteropods, Heteropods, Pteropods, and some Vermes. Here the ripe egg has mostly on its periphery a small spindle-shaped nucleus. In fishes and reptiles, as in the frog, there is a germinal vesicle with many nucleoli, some of which form the ovinucleus. After this stage Hirudineæ twice exhibit a budding from the surface of the ovum forming the so-called directive bodies, the ovinucleus contributing to them. The actual occurrences of fertilisation correspond very closely not only in animals but in plants. In Toxopneustes a single spermatozoon reaches the ripe ovum and is transformed into a small corpuscle, the sperm-nucleus, surrounded by a protoplasmic rayed figure. It travels in from ten to fifteen minutes to the central ovinucleus and is fused with it. In *Rana temporaria* the spermatozoon enters at the side of the excretory body and becomes like that of Toxopneustes, travelling to the ovinucleus and fusing with it. In Hirudineæ the spermatozoon enters subsequently to the budding of the first directive body, and after transformation gets to the centre of the ovum and there remains till the budding of the second body. Then the ovinucleus travels to the centre and is apposed to and fuses with the sperm-nucleus, which has swollen considerably. Thus in these cases the cleavage-nucleus is formed by the union of the two sexually-differentiated nuclei.

INDIVIDUAL VARIATIONS IN ANIMALS.—At the last meeting of the St. Petersburg Society of Naturalists, Prof. Wagner made a communication "On the Individual Variations in Animals, their Causes, and Results." Pointing out that the appearance of new races, varieties, and species is rendered possible by the appearance, at all stages, of the development of life of individual variations, which variations give rise afterwards to more or less constant new forms, the Professor sketched the causes of these individual variations, exterior and interior, insisting especially on the importance of these latter. The causes of variability, he said, are not only the physico-chemical influences of the medium inhabited by the individuals, *i.e.*, the exterior causes, but also, to a very important degree, the interior causes, *i.e.* those subjective physiological, and therefore also psychological, individualities which characterise each individual, and which modify to a considerable extent the influence of exterior influences on each separate representative of the species.

A NEW CHEETAH.—At the meeting of the Zoological Society on Tuesday last, Mr. Sclater described a new species of cheetah, from South Africa, differing from *Felis jubata* in the fact that the whole body is covered with spots of a dark yellow instead of black, and at the same time is considerably more thickly covered with hair. Mr. Sclater proposed the name *Felis lanea* for this apparently new species.

NORTH AMERICAN LEPIDOPTERA.—Mr. William H. Edwards has published a catalogue of the diurnal lepidoptera of North America and Northern Mexico, supplementing the well-known work by Dr. Morris, printed some years ago by the Smithsonian Institution. He enumerates no less than 506 species. This is about equal to that of the previous catalogues, the additional new species being balanced by canceling names which were synonyms or not legitimately entitled to introduction in the North American list. The special object of Mr. Edwards is to bring about what he considers a satisfactory nomenclature, dissenting from the radical changes which he insists Mr. Scudder has made in his recent divisions and lists, in few of which he concurs.

A NEW SHELL.—Mr. C. R. Thatcher, the experienced conchological collector, has just returned to this country after a five years' collecting journey through China, Japan, Philippine Islands, and Australia. He has procured several new species of Murex, Cancellaria, and one wonderful specimen of an entirely new genus. This specimen was described at the meeting of the Zoological Society on Tuesday, June 5, by Mr. George French Angas, by whom it is proposed to give the name Thatcheria, in honour of its discoverer. It was the traveller's particular aim to procure specimens of the rare *Cypræa thatcheri* and *Voluta thatcheri*, both of which he found a few years ago, for which purpose he travelled many hundreds of miles into the interior of Japan, often at the risk of his life.

GEOLOGICAL NOTES

RARE MINERALS IN THE NORTH OF SCOTLAND.—The accidental use of a mass of granite for building purposes near Tongue, in Sutherlandshire, has led to the detection of several rare minerals, and of quite a remarkable number of species and varieties associated in the same mass of rock. From among the fragments of the boulder pieces of a bright green stone were sent to the

museum of the Duke of Sutherland by Dr. Joass, of Golspie. These were afterwards analysed by Prof. Heddle, of St. Andrews, and found to be the variety of orthoclase felspar, termed amazonstone. For the purpose of more careful examination as to the mode of occurrence of this uncommon substance, Prof. Heddle has recently visited the locality, which is the side of the ridge rising to the east of the village of Tongue. He found the granite mass to be merely a large boulder, and had it thoroughly broken up. It has yielded the following remarkable assemblage of minerals:—amazonstone in simple and twin crystals, radiated cleavlandite, lepidomelane, pinite, fluorite, sphene, zircon, magnetite, ilmenite, allanite, smoky quartz with peculiar faces, and a mineral which a carefully instituted comparison shows to be thorite passing into orangite. The specimens of amazonstone obtained from the boulder are of unparalleled magnificence. One which has been sent to the museum of the Duke of Sutherland exhibited a surface of some three square feet, about a dozen large crystals, of which eight were unbroken and perfect. One crystal, unavoidedly broken in the extraction, showed the following extraordinary dimensions:—viz., a length of 15½ inches, with a breadth and thickness of ten and eight inches respectively. The minute structure of these crystals is peculiar, and has been fully described in a recent paper by Dr. Heddle on Scottish felspars in the *Transactions* of the Royal Society of Edinburgh. The exceedingly rare thorite was found in only a small quantity. From an examination of the granite of this and other boulders on the same hill, it appears that they have probably come from the huge mass of Ben Laoghal, which lies a few miles inland to the south-west. Should this be their origin, we may expect yet to find new sources of amazonstone, and perhaps other rare minerals among the numerous corries and crags of that picturesque mountain.

TERTIARY LEAF-BEDS OF COLORADO.—Mr. E. L. Berthoud, of the Territorial School of Mines, Golden City, Colorado, sends notes of a section near that place which presents some considerable resemblance to the sections in Antrim and Mull, where the miocene leaf-beds and lignites are associated with sheets of basalt and tuff. The order of succession is as follows:—

Basalt	120	feet
Lignite and leaf-bed	2½	,,
Hard mud iy clay and sandstone	13	,,
Second leaf-bed	3	,,
Clay, sandstone, conglomerate	40	,,
Third small leaf-bed in clay	2	,,
Sandstone and clay, &c.	30	,,
Basalt	25	,,

The resemblance is further borne out by Mr. Berthoud's list of plants, which includes *Platanus aceroides*, *Filicites hebridica*, *Populus arctica*, *Corylus McQuarii*, *Fagus macrophylla*, *Quercus chlorophylla*, *Sequoia*, sp. (?), *Gymnogramma Haydeni*, *Cinnamomum*, n. sp., *Ficus*, 2 sp. nov., *Magnolia*, 2 sp., *Juglans*, 2 sp., *Sabal Campbellii*, *S. Grayana*, and *S. goldianus*, *Myrica*, &c.

INFLUENCE OF ANCHOR-ICE UPON FISHING-GROUNDS.—Prof. Hind, to whose late researches in Labrador we recently called attention, has published some remarks on the effects of the formation of ground-ice in retarding the decomposition of fish offal, and thereby in seriously damaging the value of the Labrador fishing-grounds. He shows that the ice formed on the sea-bottom freezes the offal, and protects it from being devoured by sea-scavengers and from decomposition; that every rise in temperature which prevents the formation of anchor-ice promotes the decomposition of the offal; that when this takes place, as it does every year under a covering of surface-ice, the water, not being aërated, becomes foul with gases and from the removal of its oxygen, and that the result is fatal to the young cod and other fry which then seek the coasts in search of food. He states that vast multitudes of the young fish are, from this cause, destroyed every summer and autumn in the bays and fjords, and he accounts for changes which have taken place in the migratory movements of seals by this wholesale destruction of the food which they used formerly to find in the coast-waters. He recommends the utilisation of the offal, which would not only eventually prove remunerative as a source of artificial manure, but would remove the poisonous gases which are set free on the melting of the anchor-ice at a time when they cannot fail to prove highly destructive.

ORIGIN OF THE TREES AND SHRUBS IN THE SOUTH OF FRANCE.—In a recent memoir presented to the Academy of Sciences of Montpellier, the veteran professor Charles Martins discusses the history of those trees and shrubs in the south of France which suffer from severe cold, such as the carob-tree, oleander, European palm, myrtle, sweet-bay, pomegranate, olive, fig, laurustinus, ilex, vine, and others. He shows that most of these occur among the tertiary and quaternary deposits, that some of them, indeed, like the oleander (*Nerium oleander*), go back even into eocene times. He points to the fact that their remains occur in the geological formations, not only of the countries where the plants are still living, but even of tracts considerably further to the north, both in France and in Switzerland, where their living descendants or analogues could not endure the severity of winter now. The tender trees and shrubs of the Mediterranean seaboard thus serve to prove the former warmer climate of France and its subsequent refrigeration. They are merely the surviving relics of a tertiary vegetation preserved by the exceptional mildness of the climate in which they grow. A single winter of exceptional rigour, or even a single night of extreme cold, like that of January 13, 1826, when the thermometer fell to 9°·7 below zero (Cent.), would suffice to destroy them. It may be presumed, however, that during at least the height of the glacial period these tender plants were driven southwards beyond their present northern limits, and that they have subsequently crept north again.

U.S. NATIONAL ACADEMY OF SCIENCES

ACCORDING to the terms of its charter from Congress, the National Academy of Sciences must hold its annual meeting in April, at Washington. It holds also a semi-annual meeting in the autumn. Its membership has been very slowly increasing, till now it numbers nearly, if not quite, 100. At the last meeting, April 17-20, Prof. Henry presided. The Academy resolved to present a memorial to Congress, in favour of the establishment and maintenance of an International Bureau of Weights and Measures with the object of promoting permanence, precision, and uniformity in the standards, by the joint action of the leading powers of the world, according to the convention submitted to the Senate.

Five new members were elected:—Prof. John W. Draper and Dr. Henry Draper of New York, Dr. Elliot Coues of Washington, Dr. S. H. Scudder of Cambridge, Mass., and Mr. Charles S. Peirce of the U.S. Coast Survey.

The annual report of the president, Prof. Henry, recounts briefly the year's work of the Academy. The Academy reports progress in the work of preparing and publishing the scientific results saved from the wreck of the *Polaris* and in general contributed by the expedition in which that vessel was engaged. This work is in the hands of Dr. Emil Bessels, the scientific director of the expedition, and will be finished in three quarto volumes. The first volume is already published; it is a quarto of 960 pages relating to astronomy, pendulum experiments, winds, solar radiation, and meteorology in general. It is illustrated by fourteen plates, two maps, and forty woodcuts; only 500 copies of this volume were printed. The second and third volumes relate to geology, palæontology, mineralogy, botany, zoology, and ethnology. They will include a monograph on the Eskimo, illustrated by 100 plates and 200 woodcuts. The Academy has divided the income from the Bache fund, so as to

cover several distinct researches, as follows :—(1) On sun-spots and chromosphere, conducted by the late Prof. Winlock ; the results are published, with plates, in the transactions of the Harvard Observatory. (2) Magnetic survey of the United States, in charge of Prof. J. E. Hilgard ; during the year twenty-five new stations in New England and Lower Canada have been occupied ; at all the stations the dip, declination, and horizontal intensity are observed. (3) Comparisons of sensations of light ; in charge of Mr. Charles S. Peirce. The object is especially to ascertain the mathematical formula connecting the capacity of the eye for light sensations with the physical variations of radiation ; two sensations are compared, the one fixed, the other variable ; part of the results have been published. (4) Researches on the distribution of heat on the solar surface, the laws of its radiation and absorption, and effects on terrestrial climate ; conducted by Prof. S. P. Langley. (5) Researches on the laws of sound and the duration of vibrations of tuning-forks ; conducted by Prof. A. M. Mayer. The work of utilising the observations made on the transit of Venus is under direction of a committee of which the president of the Academy is a member ; progress has been made in this work, but it is scarcely yet ready for report. The endeavour to obtain an appropriation for a permanent building to display the scientific and other material contributed by the Government of the United States and other nations during the Centennial Exhibition, failed to obtain a two-thirds vote in the House of Representatives after passing the Senate without dissent. The effort will be renewed at the next session of Congress. The collections are large, valuable, and instructive, including the costly gifts of other nations, and the entire exhibit that was in the "Government Building" at Philadelphia.

During the meeting the members of the Academy were formally invited to visit the President of the United States at the White House. They were duly presented, and President Hayes expressed himself in a brief speech as fully appreciating the value of scientific pursuits, and willing and desirous to advance the interests of science. The reception was notably pleasant and cordial.

We give abstracts of the more important communications :—

Prof. Alexander Agassiz gave a brief notice of researches on the young stages of some osseous fishes. The history of previous researches on these points, since those of von Baer at the beginning of this century, was reviewed. Prof. Agassiz concludes that with few exceptions the tail begins to be formed below the dorsal cord. If embryos and very young animals are examined, a lobe is found much developed in some and common to all. The tail fin and the anal fin are probably modifications of the same organ. There is a general uniformity in the plan of construction of the tails of fishes whether osseous or otherwise.

Under the title of "Some Results of Deep-sea Dredging," Prof. Agassiz stated views partly founded upon his general knowledge and study of the products and observations made during the *Challenger* expedition, and partly upon information obtained in conversations with Prof. Sir C. Wyville Thomson and other members of the expedition. The fact of a point of zero temperature being in all oceans but varying in depth with latitudes, had been indicated by previous expeditions and was fully established by the *Challenger* observations. At the equator a depth of 500 fathoms is needed to reach this zero line ; as we approach the poles the depth of this line decreases till at last it is at the surface. Sometimes the temperature of the lower water is 2° or 3° below zero, but the conditions are, in general, uniform. Equally uniform is the fauna below this line. Above it, the arctic, temperate, and tropical faunas are clearly distinguishable from each other. There is a remarkable uniformity among the animals of the tropical fauna, such as may have resulted if in a previous era the isthmuses of Darien and Suez were absent, the Sahara was covered by the sea, and an equatorial current swept freely around the world. The deep-sea fauna is so singularly like the cretaceous that its forms would have been at once assigned to that epoch by most palæontologists if they had been fossil. The similarity if not identity of these forms indicates that there has been scarcely any change since that era. This is true of echinoderms, worms, and even of some fishes. It is equally true of some shore animals found both off our coasts and in the chalk. These have been subjected to the most varied conditions of existence as compared with their ancestors, and yet have not altered. There is evidence that natural selection, even under conditions where its forces are extreme, may not bring about any change. The present continents are probably much older than has been supposed. There is an entire want of evidence that great continents existed where oceans now are. The shore mud from our continents is washed down comparatively only a few miles from shore ; the depths are not reached by this mud. Other well-known theories need to be modified. At a depth of 2,500 feet crustacea are found having good eyes. These organs have undergone no change during innumerable centuries. There are similar facts established as to starfish. There is no very great number of blind animals in the ocean depths. Those that are blind need not be classed as retrogressions from ancestors that had eyes. Both as to blind animals in the sea and those found in caves, it seems most probable that they were the descendants of eyeless ancestors. In the discussion which followed this communication, Prof. Agassiz said that he had long doubted the theory of geologists respecting an immense miocene continent.

Prof. Joseph Le Conte, of Oakland, California, furnished a paper on critical periods in the history of the earth and their relation to evolution ; and on the quaternary as such a period. This paper instanced and enlarged upon the breaks in the geological and palæontological records, and argued that a more rapid rate of evolution had been operative during the intervals, which he designated as "critical periods." The quaternary era he regarded as one of these critical periods during which rapid changes had taken place, but it differed from most of such periods in the fact of its records being preserved.

Prof. G. K. Gilbert described the characteristics and mode of formation of the Henry Mountains.

Dr. F. V. Hayden described the results of boring artesian wells in a locality near Rawlins Springs in Wyoming Territory on the line of the Union Pacific Railroad. The district is on the dividing line of the watershed of the continent, some of the streams on the sides of the district flowing to the Atlantic, and some to the Pacific oceans. The rainfall of the district is very small—not over six to ten inches per year. The wells were bored to depths varying from 300 to over 1,000 feet. The water obtained was from 1,000 to 2,000 gallons per hour ; it was lifted by pumps driven by windmills. The result showed the feasibility of thus irrigating very arid regions. The wells were bored under Dr. Hayden's direction, in a sinclinal basin which he regarded as of tertiary formation, probably eocene ; but palæontologists who had examined its fossils had pronounced them cretaceous. Dr. Hayden regarded this as an instance where the chasm between the cretaceous and tertiary rocks was bridged over ; he stated that the rocks were consecutive from cretaceous to middle tertiary. This opinion was not fully shared by the other geologists present, and the discussion which followed became exceedingly animated, as it brought up questions long at issue between the respective students of the rocks and of the fossils of that region.

Major J. W. Powell presented some remarkable facts respecting the public domain of the United States. Dividing the United States into two portions, the humid, where the rainfall is sufficient for agriculture, and the arid, where it is not, the latter is found nearly to equal the former.

Prof. Elias Loomis, of Yale College, contributed his seventh paper of a series entitled "Contributions to Meteorology," this paper continuing the investigation of rain areas which was begun in the last. Prof. Loomis selected all the cases in the United States during fifteen months—September 1872, to November 1873—in which the reported rainfall amounted to at least eight inches in eight hours. For each of these cases the curves of equal rainfall were drawn on the map and compared. The form of these curves, though occasionally irregular, in general approximates an ellipse, of which the major axis is not quite double the minor. In these cases the area of one-inch rainfall exceeded in length 500 miles ; in six cases of one-half-inch rainfall 750 miles ; frequently the entire area is an oval of more than 1,000 miles length and exceeding 500 miles breadth. In general the rain area centre is east of the low pressure centre, but in several instances the reverse was the fact, and in some cases the rainfall appeared to have had decided influence on the storm's progress, as to its direction. It was concluded that rainfall is not essential to low barometer areas, nor the chief cause of their formation or progressive motion. Such areas result from a general atmospheric movement toward a central area, and may be caused by unequal barometric pressure, unequal temperature, or unequal amounts of aqueous vapour. The two last-named causes are not comparable to the first of the three in cogency, and only deflect the winds slightly. The progress of areas of low barometer in all latitudes is mainly determined by the same causes as those which determine the general atmospheric circulation ; their

normal direction is changed by whatever causes may change the direction of the winds.

Prof. William Ferrel, of Washington, delivered a communication on the progressive movements of storms; the object being to show that the movement of great storms is determined by the currents—especially the upper currents—of the atmosphere.

Prof. Pickering presented the results of an investigation made in connection with Prof. W. A. Rogers on systematic errors in star declination. A comparison with the mean both of the earlier and later catalogues rendered probable the existence of systematic errors in the Gesellschaft catalogue.

Prof. Simon Newcomb presented a communication on the secular acceleration of the moon and its increasing deviation from uniformity through many years. He reviewed the existing theory on the subject; the calculation of Laplace according with Halley's estimate of the acceleration as about 10″ seconds of time, to be multiplied by the square of the centuries for a given period; also the Adams theory, which reduces the explanation of Laplace to about 6 seconds, leaving more than 4 seconds to be otherwise accounted for. In ascribing the surplus acceleration to diminished rotation of the earth, we are dealing with a subject where the evidence should be carefully weighed. Much dependence seemed to be placed on the records of ancient eclipses. Prof. Newcomb considered these eclipses separately. The most promising of the Greek solar eclipses was that of Agathocles, tyrant of Syracuse, occurring at the commencement of his voyage to attack Carthage. But we do not know on which side of Sicily he sailed; according to whether he was on one or the other side of the coast, the difference of time for that eclipse may be calculated as justifying the 10 seconds or the 6 seconds acceleration of the moon. The eclipse known as that of Thales has a record open still more to criticism, because it came to its historian by hearsay, and probably through two or three generations after the lapse of a hundred years. It seems curious that if Thales predicted the year (by an estimate of lunar periods) he did not also predict the day. Each of the ancient solar eclipses yielded similar elements of doubt on careful examination. From the records of lunar eclipses if all uncertain features be weeded out, the old estimate of acceleration will be reduced one half. The Arabian records of lunar eclipses were published at Leyden in the early part of this century. The work is very rare. Altitudes of sun and moon are constantly given in it. Calculations from these eclipses give the smaller estimate of acceleration. From all the data he has been able to study Prof. Newcomb concludes that the whole amount of acceleration is about 8·4 seconds. He hopes to make further estimates from modern records, having had the good fortune to pick up in Paris carefully compiled data of occultations going back to 1680.

In introducing his communication on "a Proposed New Method in Spectrum Analysis," Prof. S. P. Langley, of Allegheny Observatory, said that in giving this title to his description of his method, he believed, and, so far as he could ascertain, was justified in believing, that the method in this special application of it, was quite new. The process consists not only in placing in juxtaposition, simultaneously, the spectra of light from two opposite edges of the sun's disc (which had been done before), but also in determining that when these spectra are taken respectively from east and west edges, the atmospheric spectrum lines still coincide, while the solar lines of the two spectra do not coincide. Prof. Langley was anxious to disclaim any intention to abate one jot of the praise due to Prof. C. A. Young for conclusively demonstrating that the difference of wave-lengths from the east and west edges of the sun can be measured and its rotation thereby be proved. The history of this line of discovery was briefly given. Zöllner, Secchi, and Hastings thought they had perceived a change in the refrangibility of the light, and Vogel, using Zöllner's reversion spectroscope, obtained a displacement of from ·08 to 0·15 of one of Angström's units. Finally, Prof. Young, using a Rutherfurd grating, showed a velocity of the sun's equator of 1m. 42s.; and also that independent measurements of solar and atmospheric lines gave different results for these two classes. Prof. Langley's new method has the advantage of great security against instrumental errors, since the two classes of lines under like instrumental conditions, betray their diverse origin. In 1875, while studying the selective absorption of the solar atmosphere, Prof. Langley constructed an apparatus for comparing homogeneous light from different parts of the solar disc; use being made of two pairs of prisms of total reflection, connected with a spectroscope so as to give spectra from different parts of disc side by side. A photometric apparatus was attached to compare the relative intensities of light in different parts of these spectra. The whole apparatus was not intended at first for the comparison of individual lines of the spectrum, a purpose for which somewhat similar arrangements had been used by Lockyer, Hastings, and perhaps others; but Prof. Young's success suggested to Prof. Langley another and cognate method of using the principle of Doppler, to which this apparatus is well adapted. For six months Prof. Langley has been engaged in overcoming the instrumental difficulties of this conception. Only within a few days has he been able to produce complete results. When the apparatus is pointed so as to receive the light from the north and south poles of the sun, the lines are continuous in the two spectra; but when the instrument is rotated so as to take light from the east and west sides, all the solar lines are found discontinuous at the junction of the spectra, while the atmospheric lines remain continuous. If the instrument is rotated 180° the solar lines again appear discontinuous, but the spectrum whose solar lines were before shifted to the right as compared with the other, will after such rotation show them shifted to the left. In order to keep clear of any bias of judgment, Prof. Langley was careful not to know beforehand which way the instrument was pointed; but the displacement in every observation tallied with the theory. Essential aid was given in the construction of the instrument by the use of the choicest of glass gratings, ruled 8,600 to 17,200 lines to the inch, which Mr. Rutherfurd, of New York, sent for the purpose of this investigation. In the higher spectra of these admirable gratings thirty-one lines are discriminated in the E group where Angström and Kirchhoff have a dozen. On actual comparison for the fine lines of that group more have been counted with the grating than with the most powerful spectroscopes consisting of trains of twelve or more prisms. The method of analysis by Prof. Langley's instrument seems less adapted to quantitative work than Prof. Young's, but in this respect it is hoped also to make it useful by employing the micrometer upon the double displacement obtainable in right and left hand spectra of the same order presented simultaneously and in combination. By the observed displacement or fixity of any line we can now discriminate certainly as to its solar or telluric origin. It is hoped that a ready means of mapping atmospheric lines will thus be afforded, since indeed they are already mapped by this process before the eye of the observer.

Gen. J. G. Barnard, U.S.A., contributed a mathematical essay, also in part historical, on the internal structure of the earth as affecting the phenomena of precession and nutation, supplementary to an article under this head in vol. xix. of the "Smithsonian Contributions to Science," being the third of the "Problems of Rotary Motion." The paper shows that Gen. Barnard has coincided in Sir William Thomson's change of view. The formation of a diurnal tide in the fluid earth is called in doubt by this paper. In general it presents work of the kind that Sir William Thomson was longing for in his Glasgow address—a solution, coherently worked out, of the problem above indicated.

Prof. O. N. Rood, of Columbia College, New York, contributed two papers giving details of his researches concerning colours. Prof. Rood used a set of brilliantly coloured circular discs representing the chief spectrum colours, and also purple. By combining in successive proportions with these colours, a white disc, and giving the combined discs rapid rotation, the following results were attained: the lighter shades of vermilion became purplish; of orange, more red; of yellow, more orange; of greenish yellow, unchanged; of yellowish green, more green; of green, blue; of cyanogen blue, less greenish and more bluish; of cobalt blue, a more violet blue; of ultramarine, violet; of violet, unchanged; of purple, less red and more violet. Exactly similar effects were produced when violet instead of white was used to reduce the colours. Hence the mixture with white is the same as if the colours were moved towards the violet end of the spectrum. Prof. Rood thinks his results tend to indicate violet as one of the primary colours, which cannot be said of Maxwell's third fundamental colour, an artificial ultramarine, or Bezold's, a blue violet, careful tests of those colours having been fully carried out. The foregoing results were laid before Mr. Charles S. Peirce. He has reported at considerable length on the mathematical principles involved. He regards the results as in accordance with Fechner's law, that the sensation is proportional to the logarithm of the excitation. When the objective brilliancy of any light is varied, the specific subjective brightness is not changed in the least; but the only effect on the sensation is to add to, or subtract from it a variable amount of a certain constant sensation, which Mr. Peirce designates as the "colour of

brightness." This ceases to be true when negative logarithms are involved. The yellow of the spectrum comes very near the colour of brightness. From these considerations a diagram has been constructed showing the colorific effects of mixing white with any part of the spectrum. The results of theory as shown by the diagram, closely accord with those of experiment upon the sensation of colour.

Prof. Rood also presented a paper on Newton's use of the term "Indigo" as a prismatic colour. It was intended to indicate the range of the spectrum between the blue and the blue-violet regions. The order of refrangibility is thus stated: prussian-blue and indigo; cobalt blue; genuine ultramarine blue; artificial ultramarine blue.

Prof. Joseph Le Conte, of California, sent a communication on the structure of the crystalline lens and its relations to periscopism. The discovery of Dr. Hermann, and his deductions therefrom, were first considered. These are that the crystalline lens, by its structure, is endowed with the property of forming distinct images of objects though lying on the extreme margins of the field of view, of forming perfect images on the retinal screen, even to the extreme anterior margins. Thus the eye has an enormous field of view compared with optical instruments. The purpose of the structure is to give periscopism to the eye. Prof. Le Conte believes, however, that as far as periscopism is concerned this structure is of little if any value in man for want of a corresponding suitable retinal structure. The indistinctness of the retinal image is different from the indistinctness of an imperfect perception of the image, the former being due to the properties of the lens, the latter to the organisation of the retina. In proportion as we go upward in the scale of animal life we find the powers of the central spot of the optical apparatus more thoroughly developed for the purposes of binocular vision.

Prof. A. Mayer, of Stevens Institute, presented four communications. He described a "Vernier microscope," which he believes to be new. The object is to substitute an accurate and permanent scale cut on glass for the varying errors of a micrometer screw. The instrument is of small cost and its errors are not varying. On a glass plate a series of lines is cut in tenths of millimetres; the central millimetre is divided into ten parts. This scale slides in carefully wrought guides in front of the objective of a firmly fixed microscope. In the focus is another scale so adjusted that ten of its parts accurately subtend the image of $\frac{9}{10}$ths of the millimetre scale. Thus a Vernier is formed which reads down to the $\frac{1}{1000}$th of a millimetre. The glass slide is so shaped that its rounded conical end abuts against the object to be measured. Readings to the full capacity of the instrument can be quickly obtained.

Prof. Mayer described his apparatus for measuring the expansion of metals and alloys under differences of temperature. It is believed that the coefficients of expansion, now inaccurately known, will be more correctly ascertained by this research.

The vibrations of tuning-forks received further investigation by Prof. Mayer; the cost of inquiry was defrayed by the Bache fund. The probable error in these determinations is the $\frac{1}{100}$ of one vibration, *i.e.*, with 256 vibrations to a second the probable error is $\frac{1}{25600}$ of a second. Differences in amplitude of vibration make no difference in the vibratory period of the fork; pressure applied to the fork also has no effect on the vibratory period, though it shortens the continuance of the note.

Prof. Mayer also described his investigations into the distribution of magnetism in long bar magnets. Some of these bars which were tested were five feet in length. Various methods have been tried for ascertaining the facts of magnetic distribution; Prof. Mayer gave due credit to other workers in this field, and described their experiments.

The Academy will hold its semi-annual meeting next autumn at New York.

NOTES

THE following is a list of the officers of the forty-seventh annual meeting of the British Association which will, as we have intimated, commence at Plymouth on Wednesday, August 15:—President Elect—Prof. Allen Thomson, M.D., LL.D., F.R.S., F.R.S.E. Vice-Presidents Elect—The Right Hon. the Earl of Mount-Edgcumbe, D.C.L., the Right Hon. Lord Blachford, K.C.M.G., Dr. William Spottiswoode, F.R.S., Dr. William Froude, C.E., F.R.S., Mr. Charles Spence Bate, F.R.S. General Secretaries—Capt. Douglas Galton, C.B., F.R.S., Dr. Philip Lutley Sclater, F.R.S. Assistant General Secretary—George Griffith, M.A., F.C.S. General Treasurer—Prof. A. W. Williamson, F.R.S. Local Secretaries—Messrs. William Adams, William Square, F.R.C.S., Hamilton Whitefore. Local Treasurer—Mr. Francis Hicks. The Presidents of the Sections are as follow:—Section A: Mathematical and Physical Science—President, Prof. G. C. Foster, F.R.S. Section B: Chemical Science—President, F. A. Abel, F.R.S. Section C: Geology—President, W. Pengelly, F.R.S. Section D: Biology—President, J. Gwyn Jeffreys, F.R.S., F.L.S. Department of Zoology and Botany, J. Gwyn Jeffreys, F.R.S., F.L.S. (President), will preside. Department of Anatomy and Physiology, Prof. Macalister, M.D. (Vice-President), will preside. Department of Anthropology, Sir Walter Elliot, K.C.S.I., F.L.S. (Vice-President), will preside. Section E: Geography—President, Admiral Ommanney, F.R.S., F.R.G.S. Section F: Economic Science and Statistics—President, the Right Hon. the Earl of Fortescue. Section G: Mechanical Science—President, Edward Woods, C.E. The reception room will be opened on Monday, August 13, at 1 P.M., and on the following days at 8 A.M., for the issue of tickets to members, associates, and ladies, and for supplying information. No tickets will be issued after 6 P.M. The first general meeting will be held on Wednesday, August 15, at 8 P.M., when Prof. Andrews, F.R.S., will resign the chair, and Prof. Allen Thomson, F.R.S., President Elect, will assume the Presidency, and deliver an Address. On Thursday evening, August 16, at 8 A.M., a *soirée;* on Friday evening, August 17, at 8.30 P.M., a Discourse by Prof. Warington Smyth, M.A., F.R.S., on the Physical Phenomena connected with the Mines of Cornwall and Devon; on Monday evening, August 20, at 8.30 P.M., a Discourse, but by whom not yet arranged; on Tuesday evening, August 21, at 8 P.M, a *soirée;* on Wednesday, August 22, the Concluding General Meeting will be held at 2.30 P.M. The local arrangements for the Plymouth meeting are not yet matured, but we believe they will include an exhibition of paintings chiefly by artists of Devon and Cornwall, including magnificent examples of Reynolds, Opie, Eastlake, Northcote, Cooke, Prout, &c. There will be excursions to Torquay or Kent's Hole, &c., and the Dart; up the Tamar or Cotehole; to the Moss Clayworks and over Dartmoor; to the Eddystone Breakwater and Government establishments; to the Caradoc mines; and to Penzance, the Lizard, the Land's End, &c.

A RECEPTION was held by the President of the Royal Society and Lady Hooker at Burlington House, on Wednesday evening June 13, which was largely attended. The invitations included ladies as well as men of science. The rooms were decorated with plants, and there was a collection of instruments and objects of scientific interest. Among the novelties were new spectroscopic instruments exhibited by Mr. Browning and Mr. Hilger; and Messrs. Tisley and Spiller's harmonograph curves, drawn on smoked glass.

A CONGRESS on Domestic Economy, organised by the Society of Arts, is to be held in Birmingham on July 18 and 19. Section A is to include (1) Needlework; (2) Cleanliness; (3) Food and Cookery; (4) Household Expenditure; (5) Thrift. Section B (6), Health; (7) Sickness; (8) The Dwelling; (9) Warming and Ventilation. Section C (10), Teaching the Subjects in Elementary Schools; (11) Text books; (12) Inspection and Government Grants; (13) Importance of Female Inspectors; (14) Examinations. A number of papers are already promised, among them being papers by Mrs. W. E. Gladstone and Prof. Huxley. The Local Committee includes the Lords-Lieutenant

of Staffordshire, Warwickshire, and Worcestershire, the Bishop of Worcester, several noblemen, clergymen, the Mayor of Birmingham, &c.

THE Helvetic Society of Natural Sciences meets this year at Bex, in Canton Vaud, from August 19 to 27. Several interesting excursions have already been arranged for. Prof. Louis Dufour, of Lausanne, will be president. English naturalists will be heartily welcomed.

THE death is announced of Lieut.-Gen. Sir Henry James, director of the Ordnance Survey of Great Britain from 1854, until his appointment to the command of a battalion of Royal Engineers in 1874, since which he has lived in Southampton in failing health. He was seventy-four years old, and from 1844, when he was director of the Geological Survey in Ireland, had written on various scientific subjects.

SOME bones of *Lithornis emuinus*, an enormous bird of the eocene period, have just been discovered in the London clay at Sheppy by Mr. W. H. Shrubsole, of Sheerness-on-Sea. Casts of these fossils will be taken for the British Museum.

THE well-known traveller, Dr. Schweinfurth, has recently returned to Egypt from a two months' journey through the Arabian desert, richly laden with scientific collections. He proceeds to Berlin to complete the arrangement of the large quantities of botanical specimens collected by him in his late expeditions.

NO. 4 of the *Quarterly Bulletin* of the Cairo Society of Geography contains a valuable account, by Dr. Nachtigal, of his visit to Wadai, as the country between Darfur and Bagirmi is called, and notes on the country of Harrar, by Mohammed Maktar. The same Society has published separately an obituary notice of the late Marquis de Compiègne, by M. C. Guillemine.

A VALUABLE and somewhat elaborate geographical sketch of Loango and the Loango Coast, by Dr. Pechuel Lösche, has been published in a separate form from the *Mittheilungen* of the Leipzig Geographical Society.

THE Annual Report for 1876-7, of the West London Scientific Association, speaks favourably of the progress of that Association, which now numbers 186 members.

IN the Buenos Ayres *Standard* of May 13 D. Francisco Moreno describes a journey he made up the Santa Cruz river, in Southern Patagonia, in about the 50th deg. of S. lat. Notwithstanding the great rapidity of the current, he succeeded, with three sailors, in ascending the river, taking thirty days to it. The Santa Cruz issues from a fine lake thirty miles long and ten broad, in S. lat. 50° 14′ 22″ and 71° 59′ W. long. D. Moreno was the first to sail along this lake, which he explored and sketched pretty thoroughly, making considerable geological collections in the neighbourhood both of this and of other lakes in the same region. Amongst these was Lake Biedma, in the neighbourhood of the still active volcano, Chalten. A river more than 200 yards wide connects Lake Biedma with Lake Santa Cruz.

MR. G. BROWN GOODE, assistant curator of the National Museum at Washington, has been engaged during the past winter in investigating the natural history of the Bermudas, and has recently returned with a large collection, filling twelve barrels and forty-three boxes, and including over 1,000 bottles of invertebratas in alcohol. His collections embrace the entire marine fauna of the coast—fishes, molluscs, worms, &c., many of which are believed to be entirely new to science.

MR. ROBERT LOWE, M.P., presided on Wednesday, last week, at a meeting of the committee formed for the purpose of organising a testimonial to Mr. John Simon, F.R.S., late medical officer to the Privy Council and Local Government Board, in recognition of the long and valuable labours he has rendered to the State, and of his eminent services to sanitary science. It is proposed that the testimonial shall assume the form of a bust in marble of Mr. Simon for presentation to the Royal College of Surgeons, agreeably to the wishes of the Council of that body. The cost, together with the expenses, will probably amount to 500*l*. We are sure that not only members of the medical profession, but all who are interested in sanitary science, will willingly contribute to a monument to one who has done so much for that science.

A SPECIAL direction of science and arts has been added to the French Ministry of Public Instruction. M. Walteville has been appointed to the new office, and it is supposed that having nothing to do with politics, he may continue in office irrespective of any change in the Ministry. It would be well to insure a continuity of action and professional independence to the head of so useful an administration.

A NEW photographic department has been established in France for the reproduction of scientific or artistic objects. The laboratory will be kept up exclusively by Government. The State photograpers will be required to employ the most advanced methods and to work for the improvement of the art.

ON Friday night a series of interesting experiments with the Jablochkoff electric light took place at the West India Docks, under the direction of M. Denayrouze. The apparatus used for the occasion consisted merely of an electro-magnetic machine worked by a small steam-engine, some insulated wires, and the electric candles, which are the invention of M. Jablochkoff, and composed, as we have already described, of two carbons placed side by side with a slip of insulating substance between them, which burns away with the carbon exactly in the same way as the wax of a wax candle is consumed with the wick. The first experiment in order to show the suitableness of the invention for dock purposes consisted in the lighting of four of the "candles" in a large yard. The light thus obtained, which was shaded by ground glass, brilliantly illuminated the inclosure, it being possible to read small print at a considerable distance from the lights, while at the same time the eyes were not affected by the glare, as is the case with the ordinary electric light. The second experiment was confined to the illumination of the top story of one of the large warehouses, and this, like its predecessor, was equally successful. A large vessel at the quay side was also lighted up, as also was a portion of the quay. The whole of the experiments were very successful, and it was stated that each "candle" gave a light equal to 100 gas lights. The light is said to be much less expensive than gas.

THE Leicester Literary and Philosophical Society have commenced the publication of its *Transactions* from its foundation in 1835, as far as material for these can now be obtained. We have received the first two parts of this publication, extending from 1835 to 1841; they contain much likely to interest not only the members of the Leicester Society, but all who take an interest in the progress of local societies, now becoming so widespread and efficient.

SOME experimental researches on the light refraction of a number of gases are described by M. Mascart in the *Annales Scientifiques*. A beam of light was sent through a collimator to two plates of plate-glass connected together at right angles; the halves of the beam were bent right and left by refraction through the glass. They then went parallel through two copper tubes containing the gases, and after refraction by a second system of glass plates placed in reverse directions, the halves were united again, and the beam passed through a slit to a system of prisms,

then to a telescope. If the pressure in one copper tube were as varied, the phases of the two parts of the beam were unlike, and from the number of fringes, the refraction of the gas could be determined. The influence of pressure was examined, then the refractive power for different wave-lengths, then the influence of temperature; and the absolute refractive power deduced from the various factors obtained. The numbers for the latter range from 0·1387 (hydrogen), and 0·2706 (oxygen) to 0·7036 (sulphurous acid), and 0·8216 (cyanogen). The refraction of a gas mixture is equal to the sum of the refractions of the mixed gases. But the refraction of a compound is in general greater than that of a mixture of the simple gases composing it.

As determinations of longitude increase an ever-increasing number of control determinations are obtained. The number of the latter in Germany and Austria is now such that M. Albrecht has considered an attempt at equalisation of the system might prove advantageous, as at least an opinion might be formed regarding the degree of accuracy of the differences of longitude directly measured, and attention would be called to the weak parts of the system. He has accordingly, with M. Sadebeck, attempted an equalisation of the system of longitude determinations between the following stations:—Strassburg, Paris, Mannheim, Bonn, Leiden, Göttingen, Brocken, Leipzic, Berlin, Vienna, Munich, and Bregenz. An account of the investigation appears in *Astronomische Nachrichten*, No. 2,132. A numerical value is assigned to the various determinations, which extend over the last fifteen years; and this was necessarily, of course, somewhat arbitrary in character. In a table M. Albrecht gives for each pair of places the difference of longitude as calculated and the difference observed, and then the difference between the two. The greatest improvements are obtained in the determinations for Leipzig-Vienna and Berlin-Vienna (the difference for the former being + 0·136s., and for the latter 0·102s.) In the former case, there was some uncertainty as to the personal equation, and in the latter two weak currents had been operated with. The improvements are, of course, only approximate, and the certainty of the individual improvements obtained is considerable only when numerous control-determinations are to hand. The result sufficiently shows that a very large number of control-determinations, and an extensive establishment of the system is necessary to remove all doubt with regard to the relative position of the various stations.

As an illustration of the rapid growth of the now celebrated *Eucalyptus globulus*, we may mention that in the more elevated parts of Jamaica trees now exist about sixty feet high, the trunks of which measure a foot in diameter near the ground. These trees have been raised from seed introduced to the island about six years ago. It is proved that in the lowland districts the tree does not thrive, thus upsetting its suitability for regions in which it was at one time specially advocated.

THE new *Journal of Forestry*, the first number of which appeared on May 1, seems to have made a good start, judging from the contents of the two numbers that have now been issued. The contents are sufficiently varied to make the journal welcome to all in any way interested in forests or forest produce, both practically and scientifically, for we find not only articles on forest work for the month, but also a brief *résumé* of Mr. Thiselton Dyer's recent address on "Plant Growth" at the London Institution.

THE additions to the Zoological Society's Gardens during the past week include two Condor Vultures (*Sarcorhamphus gryphus*), a Chilian Sea Eagle (*Geranoaëtus melanolencus*) from South America, presented by Mr. John T. North; two Chaus Cats (*Felis chaus*) from North Africa, presented by Capt. W. Renney; a Crested Guan (*Penelope cristata*) from South America, presented by Mr. Daniel Miron; a Green-winged Trumpeter (*Psophia viridis*) from Brazil, a Common Trumpeter (*Psophia crepitans*), a Demeraran Cock of the Rock (*Rupicola crocea*) from Demerara, a Black-necked Stilt (*Himantopus nigricollis*), a Sun Bittern (*Eurypyga helias*), two Orinoco Geese (*Chenalopex jubata*), a Capybara (*Hydrochærus capybara*) from South America, a Moor Monkey (*Semnopithecus maurus*) from Java, purchased; six Chilian Pintails (*Dafila spinicauda*), seven Summer Ducks (*Aix sponsa*), bred in the Gardens.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—An examination will begin on October 2 for the purpose of electing to a Physical Science Postmastership at Merton College. The postmastership is of the annual value of 80*l.* for five years, to be raised after two years, at the recommendation of the tutors, to 100*l.* The subjects of examination will be chemistry and physics; there will be a practical examination in chemistry, and candidates will have opportunities of giving evidence of a knowledge of biology. Further information from the tutor in physical science.

There will be an examination on October 11 for electing to a Natural Science Scholarship at Exeter College. The scholarship is of the annual value of 80*l.* for four years, without any limit of age. The examination will be in biology, chemistry, and physics, and candidates will be expected to show proficiency in at least two of these subjects. The examination will be to a large extent practical, but special weight will be given to a knowledge of general principles. Further information may be obtained from the Natural Science Lecturer, Prof. E. Ray Lankester.

Mr. M. J. Jackson, of University College, London, has been elected to the vacant (Holmes) Scholarship in Natural Sciences at St. John's College. The scholarship is of the annual value of 100*l.* for five years.

MANCHESTER.—Prof. Boyd Dawkins, F.R.S., has just completed his course of Field Lectures on Geology, at Owens College. Upwards of forty students—the large majority of whom were other than regular students of the College—availed themselves this year of the opportunity offered for acquiring some practical knowledge of geology. Excursions were made to the mountain limestone of Derbyshire, the coal measures near Oldham, the Permian rocks of Alderley Edge, where the copper veins disseminated throughout the sandstone were studied, and where traces of prehistoric man, in the shape of a few flint implements, were discovered. During Whit week Oxford was visited, and the Oolitic beds of the neighbourhood were explored.

During the session which has just closed, 100 students have worked in the chemical laboratories of Owens College, while the number of students attending the various courses of chemical lectures has amounted to about 200. Over a dozen original communications have proceeded from the chemical department during the session.

TAUNTON COLLEGE SCHOOL.—An address of sympathy with, and confidence in, the Rev. W. Tuckwell, head-master of the Taunton College School, is published in the local and educational papers, with the signatures of nearly all the parents. It appears that the school is heavily in debt, and that the numbers, chiefly through an attack of fever, have fallen below the paying point. The panic-stricken officials have selected the head-master as a scapegoat, attribute the loss in numbers to his "unpopularity," and are endeavouring to drive him to resign, a movement against which the parents protest in very animated terms. The part taken by this school and its head-master in working out and popularising the systematic teaching of science in company with the old-fashioned classical curriculum impels us to record these facts, and to look with interest for the result of this latest struggle between Philistinism and culture.

UNIVERSITY COLLEGE OF WALES.—A Welsh gentleman engaged in business in London, in addition to sums of 250*l.*, 2,500*l.*, and 1,100*l.* (the last sum in conjunction with his brother) previously subscribed, has just placed in the hands of the Council of the University College of Wales, a sum of money to be used in promoting scientific agriculture in Wales. According to a circular just issued, "one of the means proposed to be adopted in furtherance of this object is the delivery of courses of lectures free of charge to persons engaged in tuition in Wales, whereby they may be qualified for giving elementary instruction

in the principles of agriculture in their several schools." Prof. Henry Tanner, M.R.A.C., examiner for the section under the Government Department of Science will, on August 7 next, begin a course of twenty lectures, to be continued from day to day, at the College in Aberystwith.

THE UNIVERSITIES' BILL was read a third time in the House of Commons and passed on Monday, and a first time in the Upper House on Tuesday.

ADELAIDE.—We have received a copy of the *Calendar* of Adelaide University for 1877. This University has at present only four professors, who represent very fairly the main branches of literature and science. There is only one professor for Mathematics and Natural Philosophy, and the professor of Natural Science gives instruction in Chemistry, Geology, and Botany. We hope the University will soon be able to carry the principle of sub-division of labour into these two professorships, and thus promote efficient teaching, and at the same time relieve these two professors of a burden they ought not to be made to bear in this advanced age. There are some points in which our home universities might advantageously imitate that of Adelaide. Judging from the programme of the B.A. examination, the Adelaide graduates must be possessed of a more varied amount of knowledge than the ordinary graduates of our universities. Some knowledge of physical science (physics and chemistry), must be possessed by every graduate, and a choice of subjects is given in the second and third stages, whereby a candidate can take his degree either through literature or science. The University possesses a few valuable scholarships, one, of the value of 200*l.* per annum for three years, being awarded after examination in mathematics and natural science, the holder being required to proceed to England, take a degree in science at the London University, and undergo a training in engineering. We cannot but admire the lines on which education is conducted at Adelaide, and we trust the University may soon be able to extend its staff of teaching.

BERLIN.—The report of the Berlin University for the present year shows an attendance of 2,237 students, a decrease of 253 on the past year. The lectures are also attended by 2,080 other persons not connected with the University. The students are divided among the faculties as follows:—Theology, 135; law, 792; medicine, 297; philosophy (philology, history, &c.), 644; mathematics and natural sciences, 369. 194 students are from foreign countries, including nine English and thirty-nine Americans. The professors and privat-docenten number 200—fourteen in the theological, eighteen in the legal, seventy-four in the medical, and ninety-four in the philosophical faculties. The University library contains but 60,000 volumes, the royal library of 700,000 volumes being chiefly used.

UPSALA.—The *Abo Underrattelser* states that the Imperial Academy of Sciences of St. Petersburg will be represented by MM. Gadoline and Grote at the celebration of the 400th anniversary of the foundation of the University of Upsala.

SCIENTIFIC SERIALS

American Journal of Science and Arts, June.—An account of the discoveries in Vermont geology of the Rev. Augustus Wing (continued), by James D. Dana.—On barite crystals from the Last Chance Mines, Morgan County, Missouri, and on Göthite from Adair County, Missouri, by G. C. Broadhead.—Estimation of chromium and aluminium in steel and iron, by Andrew A. Blair.—On the chemical composition of triphylite from Grafton, New Hampshire, by S. L. Penfield.—On a new mode of manipulating hydric sulphide, by Josiah P. Cooke, jun.—On a base derived from a waste product in the aniline manufacture, by C. Loving Jackson.—On an association of gold with Scheelite in Idaho, by B. Silliman.

Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien, vol. xxvi. (Parts I. and II.), 1876.—The following are the principal papers in this volume:—Synopsis Cecidomydarum, by J. v. Bergenstamm and P. Löw.—On the structure and habits of lichens, by Dr. Arthur Minks.—On the ornithological fauna of the Austrio-Hungarian Empire, by A. Pelzeln (fourth paper).—Biology and characteristics of Psyllodæ, with description of two new species of the genus *Psylla*, by Dr. F. Löw.—On the flora of fungi in Hungary, by Fr. Haslinsky.—On the butterfly fauna of Surinam, by H. B. Möschler.—Mycological researches, by Schulzer von Müggenburg.—On the lichen-flora of New Zealand, by Dr. A. von Krempelhuber.

Reale Istituto Lombardo di Scienze e Lettere, Rendiconti, vol. x., fasc. viii.—On the encystment of the Proteus of Quanzati (*Amphileptus moniliger*, Ehr.), by M. Maggi.—Theory of reticular woodwork combined with an articulated system in modern American suspension bridges, by M. Clericetti.—The silk of the *Bombyx mylitta*, by M. Gabba.

THE *Jahrbuch der k.k. geologischen Reichsanstalt* (1876, vol. xxvi., Oct.-Dec.) contains the following papers:—On the ore deposits of the southern Bukowina, by B. Walter.—On the soda and Szek-soil in the Hungarian Lowlands, by E. von Kvassay.—On some green slate of the Saxon Erzgebirge, by Dr. E. Geinitz.—On the petrographical condition of the tuft-stones occurring in the Devonic formation at Graz, by Joh. Terglav.—On some rocks from the neighbourhood of Rosignano and Castellina Maritima to the south of Pisa, by Dr. Friedrich Berwerth.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 14.—"On the Minute Structure and Relationships of the Lymphatics of the Mammalian Skin, and on the Ultimate Distribution of Nerves to the Epidermis and Subepidermic Lymphatics," by George Hoggan, M.B., and Frances Elizabeth Hoggan, M.D. Communicated by Dr William Farr, F.R.S.

"Refractive Indices of Glass," by J. Hopkinson, D.Sc., M.A. Communicated by Prof. G. G. Stokes, Sec. R.S.

"Electrostatic Capacity of Glass," by J. Hopkinson, D.Sc., M.A. Communicated by Prof. Sir William Thomson, F.R.S.

"On the Difference of Potential produced by the Contact of different Substances," by Prof. R. B. Clifton, F.R.S.

Linnean Society, June 7.—Prof. Allman, F.R.S., president, in the chair.—Dr. Maxwell Masters read an interesting paper on the "Morphology of Primroses." Hitherto much discussion has arisen with reference to the superposition of the stamens to the petals, the free central placenta, and the nature of the ovules in the Primulaceæ. From a lengthened study and comparison of the development of the flower, minute structures, and phenomena of monstrosities, the author arrives at conclusions differing somewhat from those hitherto held. Cultivation is not the reason of the frequent structural variation, for deformed Primulaceæ in the wild state are far from uncommon; indeed the wild primrose itself is very much subject to such changes. Certain genera and species are more frequently found deformed than are others; for instance, the cowslip is less subject to change than is the primrose. Entering into all the more important variations observed by the author and recorded by others, in various parts of the flower, he sums up: (1) That the petals of most Primulaceæ are late outgrowths from the receptacular tube. (2) That the placenta is a direct prolongation of the receptacle or axis, and without apex or side connection with the carpels. (3) The placenta occasionally in monstrous flowers arises from the margin or centre of carpel, but sometimes is detached, the detached placentæ cohering like a solid column. (4) Staminal and carpellary leaves may occasionally be divided or lobed. (5) The ovular coat is essentially foliar, representing blade or undivided leaf, and is not a direct production from the axis. (6) Processes of carpellary leaf may be infolded, thus forming secondary carpels.—The Rev. G. Henslow followed by a "Note on the causes of numerical increase of parts of plants." In this he classified the various methods and causes of the increase of parts of leaves and floral whorls, more especially with the view of limiting each of the various kinds to its proper cause respectively.—The secretary briefly indicated the contents of a paper by Mr. Marcus Hartog, "On the floral development and symmetry in the order Sapotaceæ." From the extracts read of this communication it appears the author, from observation of growing plants in Ceylon has independently arrived at and here brought forward further evidence tending to the same results propounded by the two foregoing home botanists.—"On the nymph stage of the Embidæ, with notes on the habits of the family, &c.," was next read by the author, Mr. R. McLachlan. He stated that in 1837 Prof. Westwood (in *Trans.* Linn. Soc.) instituted the characters of *Embia*, a genus of insects allied to the white ant. Lately (therefore forty years after) Mr. Michael, of Highgate, discovered some orchids partially destroyed by an insect found to belong to the Embidæ, and subsequently the nymph form obtained fills a gap in the insect's history. Mr. McLachlan, in allusion to the habits, recorded by Mr. Lucas and others, mentioned its being carnivorous and spinning a silken web like that of a spider, which, however, Mr. McLachlan believes to be for

protection from its enemies, while he doubts its carnivorous propensities, regarding it as probably a vegetable feeder. He then entered into the subject of systematic position, structure, distribution, number of species, concluding with a detailed description and zoological remarks on those forms of the Embidæ now known. He observed that the larvæ of a species of *Embia* has been noticed in fossil amber. The living forms inhabit both hemispheres at spots wide apart. None are known from Australia.—Mr. G. Busk verbally explained the more important points in the succeeding paper, viz., "Observations on British Polyzoa," by the worthy field naturalist, Mr. Charles Peach. The latter has faithfully described and delineated a number of forms of this marine family, some of which he regards as new to science, and of other known genera and species he adds much information regarding their habits and history. For instance, *Scrupocellaria scruposa* he shows has tubulous wool-fibre-like roots armed with spines, and by which it attaches itself to certain sponges, &c., a fact previously unknown.—A notice of the Lichens of the *Challenger* expedition, by the Rev. J. M. Crombie, and on Crustacea inhabiting certain hollow sponges, by Mr. Edward J. Miers, were two papers read in brief extract.

Zoological Society, June 5.—Prof. W. H. Flower, F.R.S., vice-president, in the chair.—A communication was read from Dr. A. B. Meyer, inclosing a paper by the late Dr. Bowerbank, describing five new species of sponges, discovered by Dr. Meyer at the Philippine Islands and New Guinea during his recent travels in the Eastern Archipelago.—A communication was read from Mr. E. L. Layard, F.Z.S., containing some remarks on the exact localities of certain species of Birds of the Islands of the South Pacific.—A second communication from Mr. Layard contained remarks on a paper by Mr. R. B. Sharpe on the Cuculidæ of the Ethiopian Region.—A communication was read from Mr. Arthur G. Butler containing an account of a collection of Lepidoptera, made at Cape York and on the south-east coast of New Guinea by the Rev. J. S. MacFarlane. Of these five butterflies and four moths were described as new to science.—Dr. A. Günther, F.R.S., read a report on a collection of fishes made during the late Arctic Expedition by Mr. Hart, Naturalist on board H.M.S. *Discovery*. Among them was a new species of Charr, from a lake near the winter-quarters of the *Discovery*, which was proposed to be called *Salmo naresi*.—A communication was read from Mr. D. G. Elliot, F.Z.S., containing a review of the genera and species of Ibidinæ or sub-family of Ibises.—A communication was read from Mr. Martin Jacoby, containing the descriptions of some new species of Phytophagous Coleoptera from various parts of the world.—Messrs. P. L. Sclater and O. Salvin read descriptions of six apparently new species of birds from collections lately received from Ecuador and Peru. Amongst these was a remarkable new duck of the genus *Fuligula* from the vicinity of Lima, Peru, proposed to be called *Fuligula nationi* after Prof. Nation, its discoverer.—Mr. A. H. Garrod read the third part of his series of papers on the anatomy of Passerine birds, and treated specially of some modifications of the Tracheophonine larynx which he had lately ascertained to occur in the genera *Pteroptochus* and *Grallaria*.—Mr. George French Angas communicated notes on a collection of land and fresh-water shells from South-west Madagascar; amongst these Mr. Angas pointed out three new species of *Helix*, one of *Bulimus*, and one of *Physa* which he proposed to call *Helix waterst*, *H. balstoni*, *H. ekongensis*, *Bulimus balstoni*, and *Physa madagascariensis*.—A second communication from Mr. Angas contained the description of a remarkable shell from Japan, which he named *Thatchera mirabilis*, also the description of a new species of *Leiodomus* from Kurrachi, Scinde, proposed to be called *L. kurrachensis*.

Entomological Society, June 6.—J. W. Dunning, vice-president, in the chair.—Mons. Réné Oberthür, Rennes, France, was elected a foreign member.—Mr. J. W. Douglas exhibited sixteen species of *Psyllidæ* (four of them being new to Britain), which he had taken during the latter half of 1876. Mr. Douglas took the opportunity of calling the attention of entomologists to the wide field for investigation offered by these insects, the economy of many of the species being still quite unknown.—Mr. F. Grut exhibited a white downy nest from Jamaica supposed to be the work of some insect.—Mr. H. Goss exhibited a dark variety of *Cleora glabraria*.—Mr. C. O. Waterhouse exhibited a magnificent dragon-fly from Borneo. This insect, which is new to science, he has proposed to name *Gynacantha plagiata*. The specimen, a female, measured more than six inches in expanse.—The Secretary read a circular from Dr. Buchanan White, of Perth, soliciting specimens of *Hemiptera* (especially exotic) from entomologists, as he was engaged in working out that order of insects.—Dr. Sharp communicated a note on some species of Rhyncophorous beetles from New Zealand, which had been sent to Dr. Leconte for examination.—Mr. Pascoe made some remarks upon the foregoing note.—Mr. J. W. Slater communicated a paper on the food of gaily-coloured caterpillars, in which he attempted to show that brightly-coloured larvæ generally fed upon poisonous plants.—A discussion ensued, in which Messrs. Dunning, McLachlan, Waterhouse, and Meldola took part. Mr. Meldola called the attention of the Society to the explanation of the subject given by Wallace in 1867, and exhibited some butterflies which were the sole survivors of an old Indian collection, the greater part of which had been demolished by mites. The surviving specimens all belonged to protected genera (*Euplœa*, *Danais*, and *Papilio*), proving that the quality which rendered these insects distasteful was, to a certain extent, retained after death.

Anthropological Institute, June 12.—Col. A. Lane Fox, F.R.S., vice-president, in the chair.—Mr. W. J. Knowles, of Ballycully, read a paper on some recent discoveries of flint implements, worked bones, and other objects in a kitchen midden at Ballintoy, co. Antrim.—The director then read some notes on customs of the Caledonia women of Stuart's Lake and Fraser Lake Indians, and two legends of the Langley Fort Indians, by Mr. Gavin Hamilton, of the Hudson Bay Company (communicated by Dr. John Rae, F.R.G.S.)—Staff-Surgeon Messer, R.N., M.D., then made some interesting observations on the subject of poisoned arrows, as used by the South Sea Islanders, and the effects, moral and physical, of them on Europeans and blacks.—Mr. G. M. Atkinson exhibited for the Rev. J. C. Roger, Rubbings from a Runic inscription found on a stone in Cunningsburgh churchyard, Shetland Isles, and of a stone with Oghams, found five feet below the surface at Lunnasting, Shetland Isles.

Victoria (Philosophical) Institute.—The Rev. Isaac Taylor read a paper on the history of alphabets. De Rouge's great discovery has proved that the alphabet is the oldest existing monument of human civilisation—older than the pyramids. There were three stages in its invention:—1. Ideograms—pictures of things. 2. Phonograms—symbols of words and syllables. 3. The letters of the alphabet. After giving a brief account of the syllabic writing which was developed by the Japanese out of the Chinese, and by the Cypriotes out of the Cuneiform, he went on to explain De Rouge's discovery of the mode in which the Semites had selected twenty-two letters out of the 400 Egyptian hieroglyphics, and thus formed that first alphabet which had been the parent of all alphabets in the world. He showed how all the alphabets of the world were to be traced, by means of the Moabite stone, to their source in the Egyptian hieroglyphics. He went on to explain the causes of alphabetic change:—1. Those due to nature of writing materials—clay, stone, papyrus, parchment, palm-leaves. 2. Indolence in the writing. 3. Need of legibility.

CAMBRIDGE

Philosophical Society, May 21.—Mr. Pearson read a paper on one passage in Hesiod and three in Ovid's Fasti, which he said he considered might be properly tested and illustrated from modern astronomy. Admitting, as is often averred, that many allusions of this nature in the classical authors are inaccurate or wrong, some he thought might be still found to have the stamp of truth about them. Hesiod says (Op. et Di. 564-67) that sixty days after the winter solstice Arcturus rose during twilight in the evening. Arcturus's position for January 1, 1875, is given in the *Nautical Almanac* as R.A 14h. 9m. 55s., Dec. 19° 50′ 22½″ N. If we convert these data into latitude and longitude, reduce the star's longitude by about 36° 10′, which, at the annual rate of 50″·1 for *precession* will bring us to about 730 B.C., and reconvert the star's new *longitude* and *latitude* into R.A. and Dec., we shall find that the position of the star in the early part of the eighth century B.C., which may be fairly taken to represent the era of Hesiod, was something about 12h. 6m. R.A. and 33° 30′ north dec. On Feb. 20, at that time, in lat. 38½° N., about the situation of Ascra and Helicon, the sun would set about 5.40 P.M., while Arcturus would rise above the horizon about 5.53 P.M., a relative position of the two luminaries which fairly answers to the words of the poet. And while investigating the position of the star, Mr. Pearson said he found he had unintentionally explained, as he believed, the epithet "late-setting," applied to Arcturus in Hom. Od. E′ 272. Arcturus at that epoch would first have been visible at the time of its morning setting about May 24, and would set June 1 at 3.30 A.M., July 1 at 1.32 A.M., Aug. 1 at 11.30 P.M. During the early summer,

therefore, when the Greek seaman or agriculturist was often spending the nights out of doors, the late time at which this brilliant star would set must have been quite unmistakable, and Ulysses is naturally described as keeping his eye fixed on it while sailing eastwards, as carefully as he kept the Bear on his left. Again in the "Fasti" of Ovid, i. 654, ii. 76, we are told that Lyra, or *Vega*, was last visible when setting in the evening, about February 1. "Ubi est hodie, quae Lyra fulsit heri?" Employing again the method of calculation indicated above, we find on that day at Rome the sun would set about 5.10 P.M., and Lyra about 5.44. As the days at that time of the year are rapidly lengthening, while the star would set earlier every day, it is obvious that the date assigned for the last appearance of the latter is nearly exact. Ovid's references to Arcturus are not at first sight so satisfactory. May 26th and June 6th ("Fasti v. 733, vi. 235) are both assigned as the first days on which he is visible, probably by a mistaken reference to two different modes of calculating the time of a star's rising. On May 26 the star would rise at 4.25 A.M., on June 6 at 3.43 A.M. The sun on the former day rises at Rome about 4.35, and on the latter at 4.30 A.M. If we consider Ovid to have consulted two different authorities, one of which gave the true and the other the visible heliacal rising of the star, no reasonable exception can be taken to the value of his statements. He makes, however, a remark about Capella which seems really erroneous. He says ("Fasti" v. 113) that she rises on May 1st, *i.e.*, is then first visible in the morning. But at the time when Ovid lived she would, according to the mode of computation used in the previous examples, have risen about 3.0 A.M., while the sun would not have risen until after 5.0. We have a similar apparent mistake in Pliny and Columella, nearly contemporaries, who fix Arcturus' rising for the 23rd or 21st of February. On that day the sun would set at Rome about 5.35 P.M., whereas the star would not pass the horizon before 6.30 P.M. They seem to have copied from Hesiod without any thought. The late Mr. F. Baily, in his edition of "Ancient Star Catalogues," published in vol. xiii. of the *Memoirs* of the Royal Astronomical Society, does not seem to have actually compared the positions there given to any of the principal stars with those which in the present day we must suppose them to have then occupied. As, however, the present rate of change in the obliquity of the ecliptic would have made it in the time of Eratosthenes (230 B.C.) about 23° 43′, whereas that astronomer fixes it roughly at 23° 51′, it is to be hoped that, making allowance for inaccuracies in the MSS., such a process of verification may be attempted with some prospect of success; and possibly some explanation found of Ptolemy's idea that in his time (A.D. 140) the amount of annual *precession* was only 36″.—Mr. J. W. L. Glaisher communicated to the society a ten-figure table of the values of e^x and e^{-x}, with their logarithms from $x = 1$ to $x = 500$ at unit intervals. The table was intended to accompany Prof. F. W. Newman's table of e^{-x}, and will appear with it in the *Transactions* of the Society.

PARIS

Academy of Sciences, June 11.—M. Peligot in the chair.—The following papers were read:—On the densities of vapour; reply to M. H. Sainte-Claire Deville, by M. Wurtz.—On the atomic notation; reply to M. Berthelot, by M. Wurtz.—Second note on the *Nouvelle Navigation* of M. Villarceau, *apropos* of the interior sea of the Algerian Sahara, by M. Naudin. He urges that the result would very probably be an immense pestilential focus. The slope would be slight, and the depth of water in the border of the lake small. A large portion of land would thus be alternately covered with water in the rainy season, and left dry in the summer; and with the mixture of salt and fresh water, bright solar light, and tropical heat during two-thirds of the year, there would be active generation of organisms, the putrefaction of which must corrupt the air all round.—Theory for finding the number of co-variants and contra-variants of order and degree, given, linearly independent of any system of simultaneous forms containing any number of variables, by Mr. Sylvester.—On the rotatory polarisation of quartz, by MM. Soret and Sarasin. They have extended their researches to the ultra-violet radiations, using the light had from induction sparks between cadmium points and applying the spectroscope with fluorescent eyepiece.—Observations on the ovigerous tubes of the Phylloxera, by M. Boiteau.—Results obtained at Cognac since 1875, by the use of alkaline sulpho-carbonates, by M. Monillefert.—On the use of sulpho-carbonates, by M. De Georges.—On a new electric lamp with oblique circular rheophores, by M. Regnier. He was led to this arrangement from having observed that with rheophores meeting angularly the most of the light was emitted at the summit of the angle. The occultations—hitherto inseparable from carbon discs—are suppressed. Each rheophore has its own clockwork, movement, and the motors, pivoted, can oscillate with their respective rheophores. One is manœuvred by the operator, who puts the carbons in position; the other, commanded by a solenoid in the circuit, oscillates automatically, bringing the carbons in contact, or separating or approximating them at the proper time.—M. Cance presented a new system of electro-magnets with multiple cores, in which M. Camacho's tubular cores are replaced by small soft iron rods juxtaposed, and enveloping, two by two, the different layers of spiral; this gives certain advantages.—M. Trouvé presented an improved sound for wounds caused by fire-arms.—On the infinitely small displacement of a dihedron of invariable size, by M. Mannheim.—Historical remarks on the theory of motion of one or several bodies, of constant or variable forms, in an incompressible fluid (continued), by M. Bjerknes.—On certain functions, similar to circular functions, by M. Appell.—Comparative study of observations by day and by night; second note, by M. Perrier. He finds that azimuthal observations by night have a degree of precision at least equal, if not superior to that of observations by day, and thinks they should forthwith be introduced into the practice of geodesy.—On the determination of the zenith of a ship or point observed at sea by means of straight lines of height; insufficiency of the zenith or place of the ship called *the most probable*; determination of a point nearest the true zenith, by M. Bertot.—Researches on the use of magneto-electric machines with continuous currents, by M. Gramme. With baths coupled in tension, M. Wohlhill, of Hamburg, got a deposit corresponding to 43 kilogr. of silver per hour, while expending 15-horse power on the machine. M. Gramme describes several experiments by himself of this nature.—Influence of a mechanical action on the production of various hydrates in supersaturated saline solutions, by M. Gernez.—On the new general method of synthesis of hydrocarbides, acetones, &c., by MM. Friedel and Crafts.—Researches on normal propylene, by MM. Reboult and Bourgoin.—Composition of a substance formed on an iron rod altered by a Siemens gas furnace, by M. Terreil. Under the simultaneous action of the oxidising and reducing gases of the furnace, the iron was transformed almost wholly into anhydrous protoxide of iron. M. Daubrée made some remarks on this.—On the asparagine of amygdalene; hypothesis on its physiological *rôle* by M. Portes.

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